



New Zealand Aluminium Smelters Limited

Annual Environmental Monitoring Report 2018

*Report to Environment Southland
on consent monitoring and environmental effects of the
Tiwai Aluminium Smelter for the year ending 31 December 2018*

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Summary

Introduction

This report contains the results of consent monitoring and environmental effects of New Zealand Aluminium Smelters for the year ending 31 December 2018.

Main Stack

Main Stack discharges to air were within permit standards during 2018.

In November 2018 Environment Southland approved NZAS to use continuous monitoring instrumentation to collect data for Main Stack emissions. This methodology will replace the current monthly manual method and will take effect by mid-2019 once installation, commissioning and a Relative Accuracy Assessment has been completed by an independent competent 'third party' organisation.

Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2018.

Dust Collector Discharges

13 dust collectors were tested during 2018. All dust collectors sampled were within permit limits.

Dispersion

Wind speeds and direction were generally similar to previous years.

Monthly rainfall for 2018 was variable with an extremely dry January of only 20mm. The total annual rainfall 987mm is very similar to the 5 year running average of 923mm.

Ambient Air

Gaseous and particulate fluoride levels were marginally elevated to previous years however still well below our consent limits.

Atmospheric Deposition

Fluoride levels at both sites were similar to previous years.

Vegetation

The fluoride concentrations of ungrazed grass sites during 2018 were similar to the concentrations measured in previous years.

Water Take

Water take from the aquifer was within permit standards for 2018.

Liquid Discharges

Discharges from the North, South, and West drains and of Treated Effluent and their effect on the environment were within permit standards during 2018.

All permit standards were met for Treated Sewage discharges during 2018.

Groundwater monitoring results from the sewage monitoring bores showed no significant changes of analytes during 2018.

Groundwater

Groundwater monitoring around the SCL storage shed and underneath the storage shed showed no significant changes of analytes during 2018. The cathode pad stockpile groundwater showed no significant changes of analytes during 2018.

Landfill

Monitoring of groundwater near the NZAS landfill showed no significant changes of analytes during 2018.

Greenhouse Gas Discharges

The total calculated carbon dioxide equivalent (CO₂-e) discharge from NZAS during the year ending 31 December 2018 was up 4% on last year. The average emission rate in 2018 was 2.04 t CO₂-e / per tonne of aluminium produced.

Significant Spills

There were no significant spills to report in 2018.

Reporting

There are no Parts G or H in this report. Monitoring associated with fluoride in pinus radiata (previously reported as Part G) and grazing monitor farms (previously reported as Part H) was discontinued several years ago. To ensure continuity within Annual Reports the nomenclature for all other Parts remains constant.

Part A – Environmental Management

Introduction

This report summarises NZAS' environmental performance during 2018 and includes results, summaries and comments on discharge permit monitoring. It includes data from some reports forwarded to Environment Southland during the year with additional sections including discharges to air, dispersion conditions, spills, liquid discharges etc. to cover NZAS' discharges to, and effects on, the environment.

The data is provided in tables, summaries, maps and where appropriate as graphs. Analysis of trends and other comments are included where appropriate.

The NZAS Laboratory team provides much of the data within this report. An auditing programme conducted by Environment Southland verifies the validity of this data.

NZAS' Laboratory has maintained accreditation to NZS/ISO/IEC 17025 "General Competence of Calibration and Testing Laboratories". The scope of the accreditation includes Quality Systems to ensure the accuracy of data. Where samples are forwarded to external laboratories for analysis, these laboratories have accreditation to NZS/ISO/IEC 17025.

Environmental Incidents

There were no environmental regulatory violations in 2018 however the following minor incidents occurred:

- Feb 2018: Main stack test was aborted due to a medical event.
- May 2018: Site wide power outage for 15 mins resulting in loss of control to all emission control equipment including dry scrubber, main stack and baking furnaces.
- May 2018: Increased dust emissions from unloading of alumina for 15 mins while having two holds open at the same time to place a loader into the hold for reclamation of alumina. Community complaint.
- Sept 2018: Excessive black smoke emitted from X Furnace in the cast house. Within consent limits. Air control unit/burners failed and remedial work commenced. Community complaint.
- Oct 2018: Excessive black smoke from X Furnace. Work was progressing but not resolved when this second community complaint was received. Remediate work was completed late October 2018.

Part B - Discharges into Air

Introduction

Discharges into air from the smelter and wharf were covered by Air Discharge Permit Number 93566 prior to June 2006. A new Air Discharge Permit Number 203378 was issued on the 6th June 2006 and amended on 22nd December 2014.

Potline 4 was restarted during October – December 2018 which has resulted in additional discharges to air. Potline 4 was last operational in 2012.

This Chapter covers:

- Main Stack discharges,
- Potline Roof Louvre discharges,
- Fluoride discharges into air,
- Dust Collector discharges,
- Main Stack smoke discharges, and
- Sulphur contents of raw materials and fuels used in the aluminium smelting process.

Main Stack Discharges

Monitoring results

The following tables show the main stack monitoring results for 2018.

Parameter	Units	Running 12 month average	
		Permit Limit	2018
Gas flow rate	Sm ³ / min	-	57,100
Total particulate	kg/min	1.70	1.09
Gaseous fluoride	kg/min	0.50	0.16
Particulate fluoride	kg/min	0.20	0.03
Sulphur dioxide	kg/min	21.4	12.2
Total condensable hydrocarbons	kg/min	-	0.07
Polycyclic aromatic hydrocarbons	kg/min	-	0.027

The following table shows the monthly maximum values. Discharges of these contaminants shall not exceed the following maximum values in eleven out of 12 months.

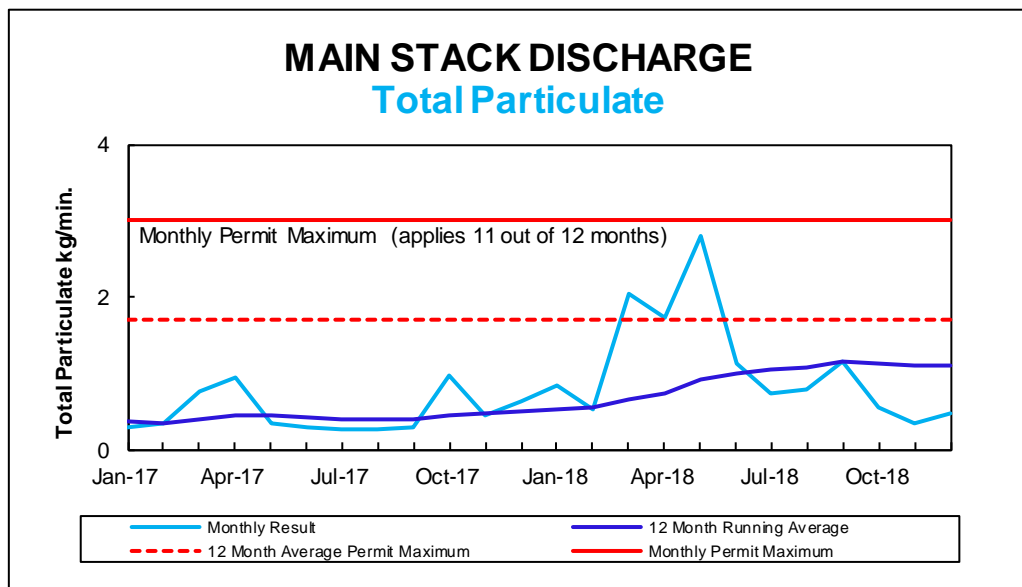
Parameter	Units	Monthly Results		
		Limit applies 11 out of 12 Months		
		Permit Limit	Maximum	Number of times > Limit
Total particulate	kg/min	3.00	2.81	0
Gaseous fluoride	kg/min	0.65	0.31	0
Sulphur dioxide	kg/min	23.0	14.6	0

Main Stack Discharges, continued

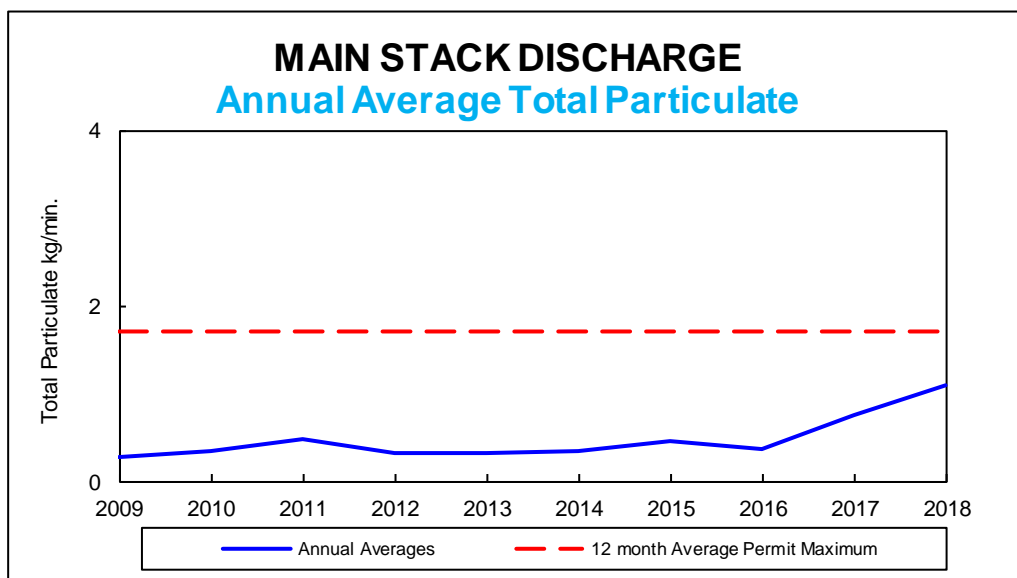
Total Particulate

Permit: 12 month running average not to exceed 1.7 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack total particulate discharge during 2017 and 2018.



The following graph shows the annual average main stack total particulate discharge.

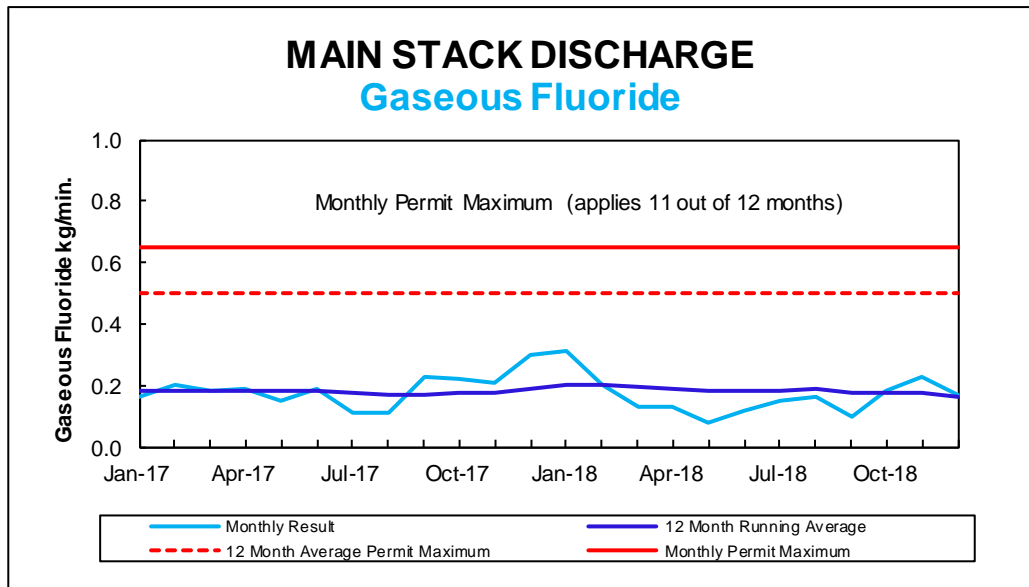


Main Stack Discharges, continued

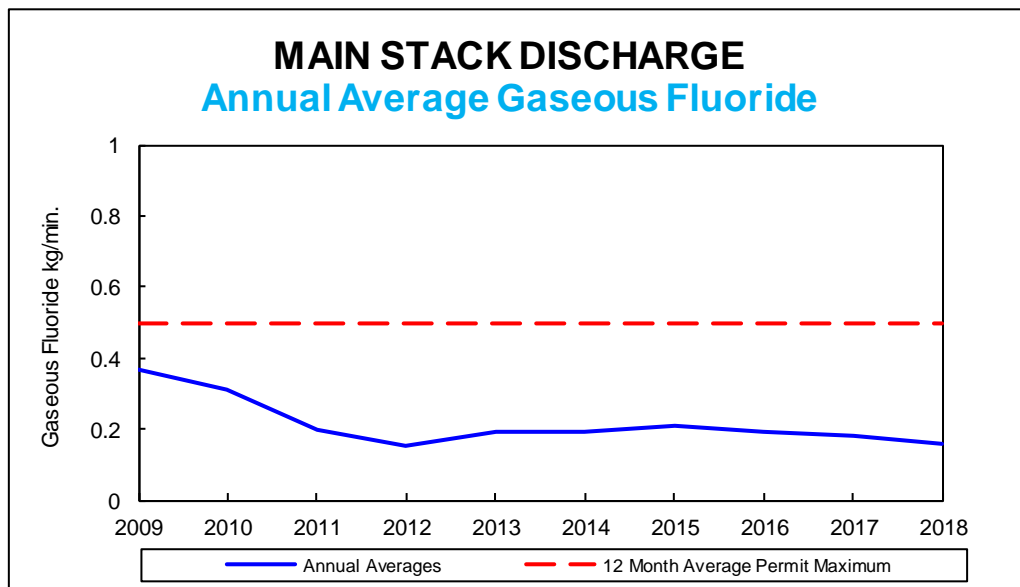
Gaseous Fluoride

Permit: 12 month running average not to exceed 0.5 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack gaseous fluoride discharge during 2017 and 2018.



The following graph shows the annual average main stack gaseous fluoride discharge.

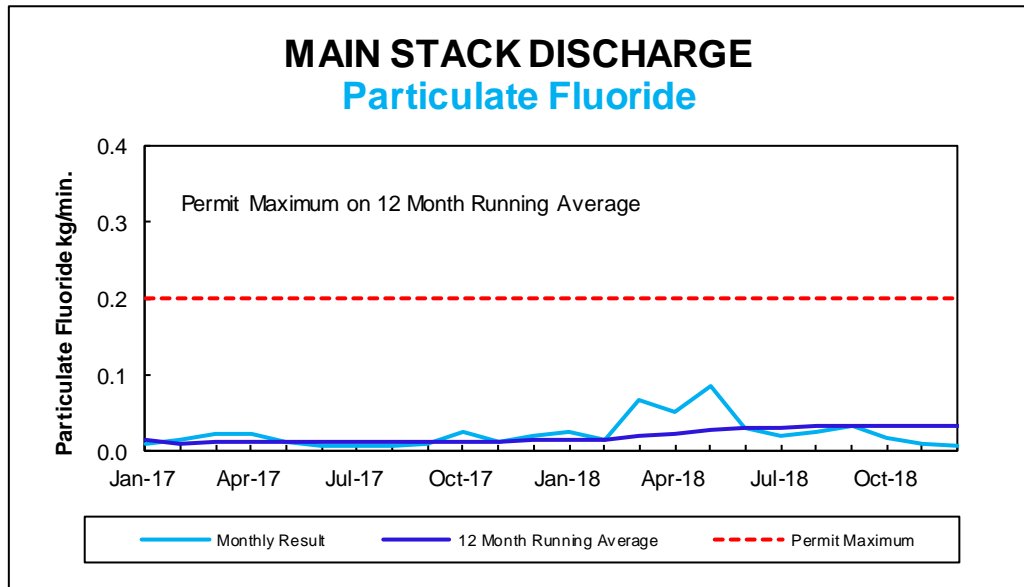


Main Stack Discharges, continued

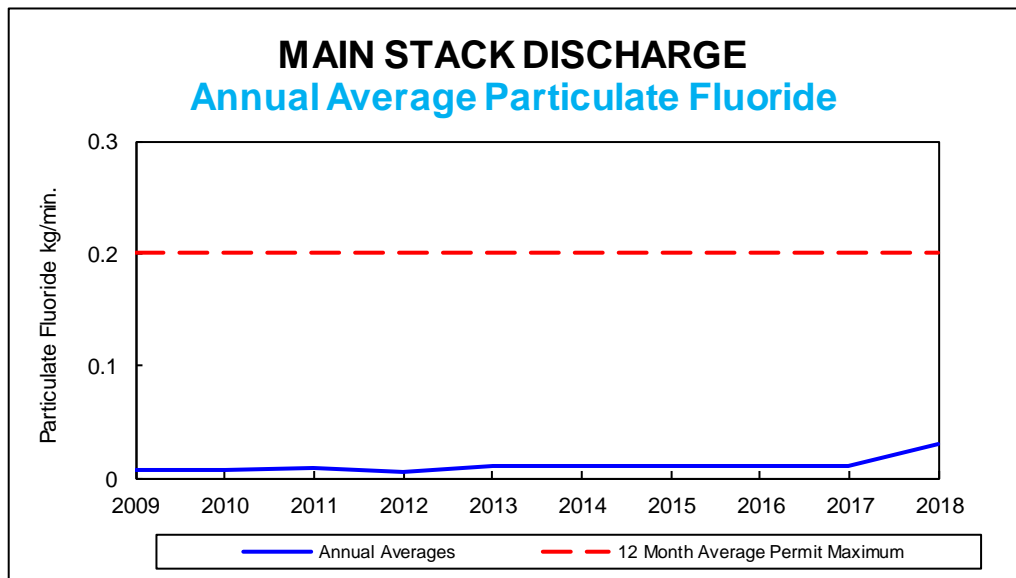
Particulate Fluoride

Permit: 12 month running average not to exceed 0.2 kg/min.

The following graph shows both the average monthly and the 12 monthly running average main stack particulate fluoride discharge during 2017 and 2018.



The following graph shows the annual average main stack particulate fluoride discharge.

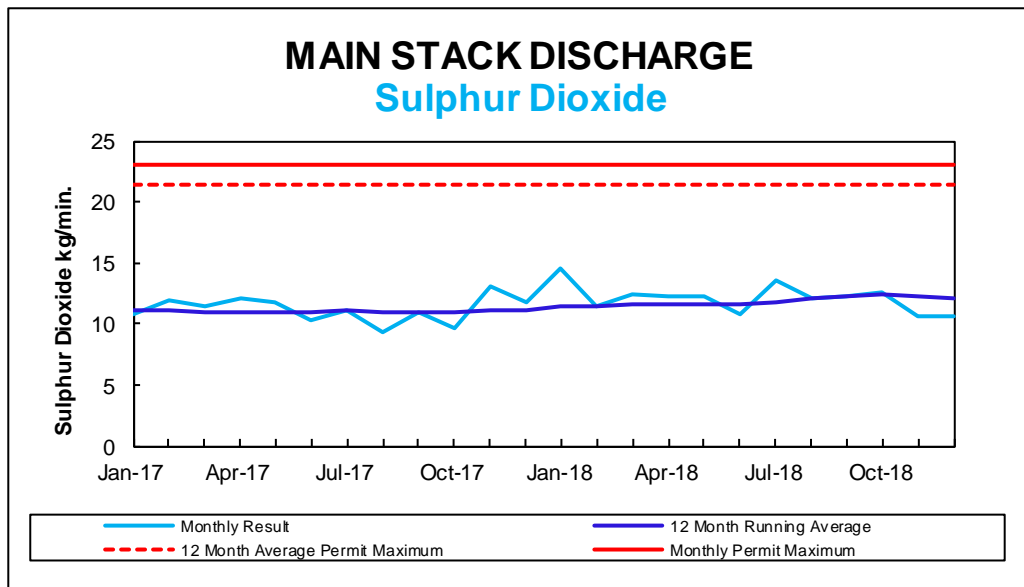


Main Stack Discharges, continued

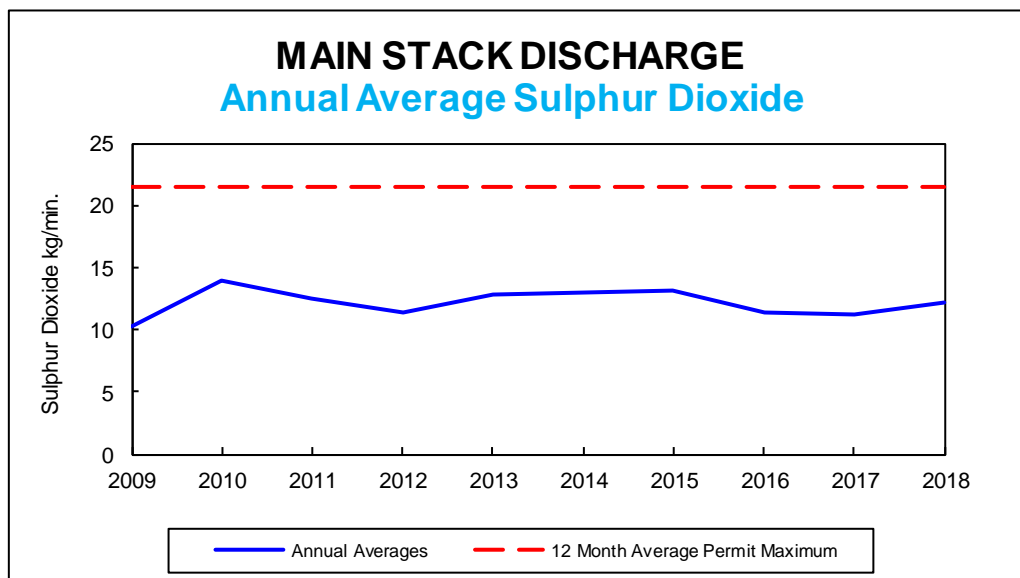
Sulphur Dioxide

Permit: 12 month running average not to exceed 21.4 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack sulphur dioxide discharge during 2017 and 2018.



The following graph shows the annual average main stack sulphur dioxide discharge.

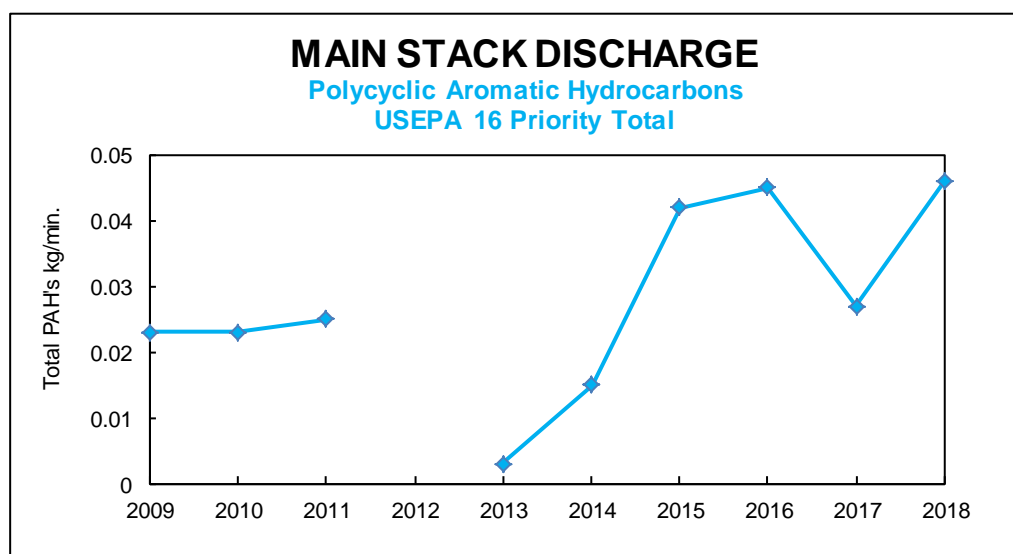
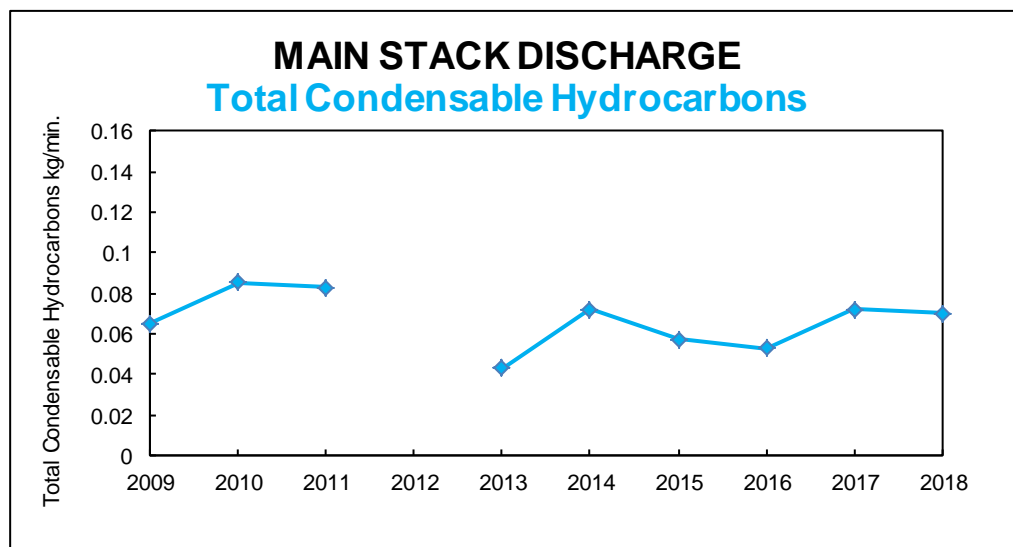


Main Stack Discharges, continued

Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons

The annual analysis for total condensable hydrocarbons (TCH) and 16 USEPA priority PAH's was carried out in February 2018. The following graphs shows the annual TCH discharges and the 16 USEPA priority PAH's.

Note: A dispensation was granted by Environment Southland for NZAS not to carry out this monitoring in 2012.



Comments

The discharge of total particulate, sulphur dioxide, particulate fluoride and gaseous fluoride from the Stack were within permit limits for 2018. Total particulate has increased significantly over the last 2 years.

Due to an incident the February 2018 stack test was aborted. Further attempts for this test were prevented due to a lack of available staff. Data reported for February is a calculated average of the previous 12 months data.

The level of total condensable hydrocarbons (TCH) has remained at the level found in 2017. The levels of the 16 USEPA priority PAH's has risen back to levels found in 2015 and 2016. No TCH and PAH monitoring was undertaken in 2012.

Potline Roof Louvre Discharges

Monitoring results

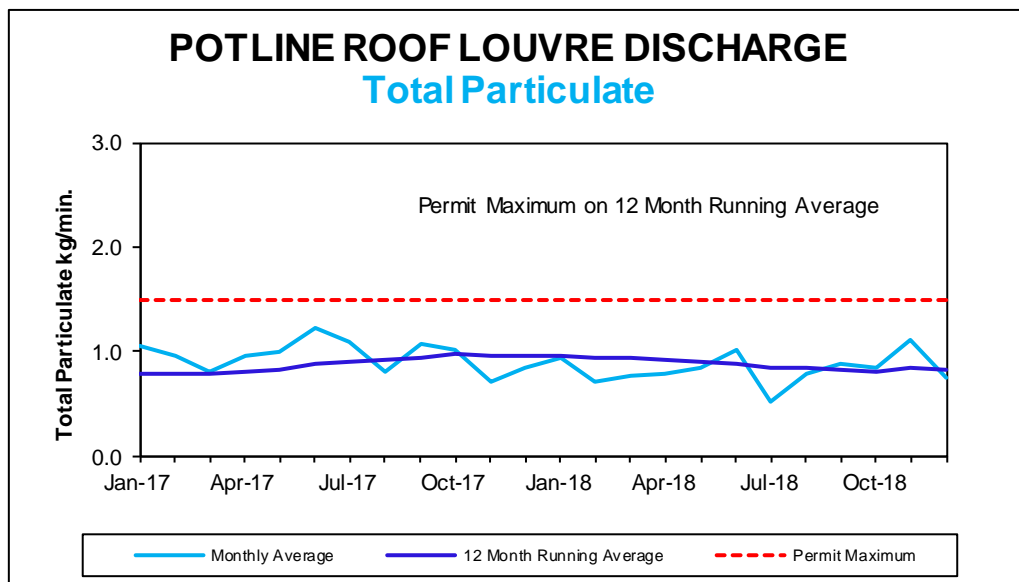
The table below shows the Potline roof louvre monitoring results for 2018. The permit limits are for 12 month running averages. There is no permit limit on maximum emissions in any given month.

Parameter	Units	Running 12 month average		
		Permit Limit	2018	Maximum for any month
Total particulate	kg/min	1.50	0.83	1.10
Gaseous fluoride	kg/min	0.21	0.18	0.30
Particulate fluoride	kg/min	0.30	0.17	0.24
Sulphur dioxide	kg/min	0.55	0.30	0.50

Total particulate

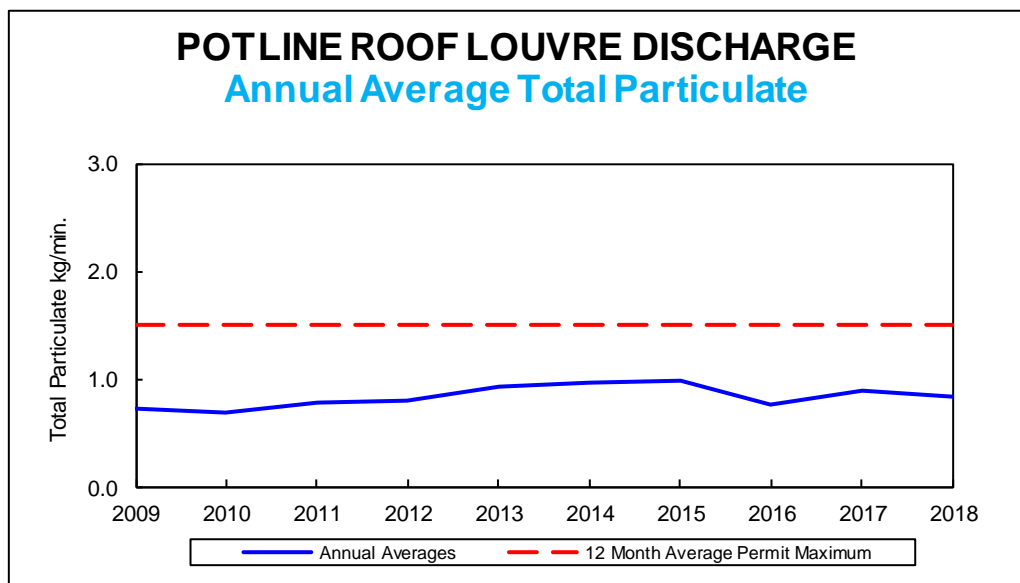
Permit: 12 month running average not to exceed 1.50 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre total particulate discharge during 2017 and 2018.



Potline Roof Louvre Discharges, continued

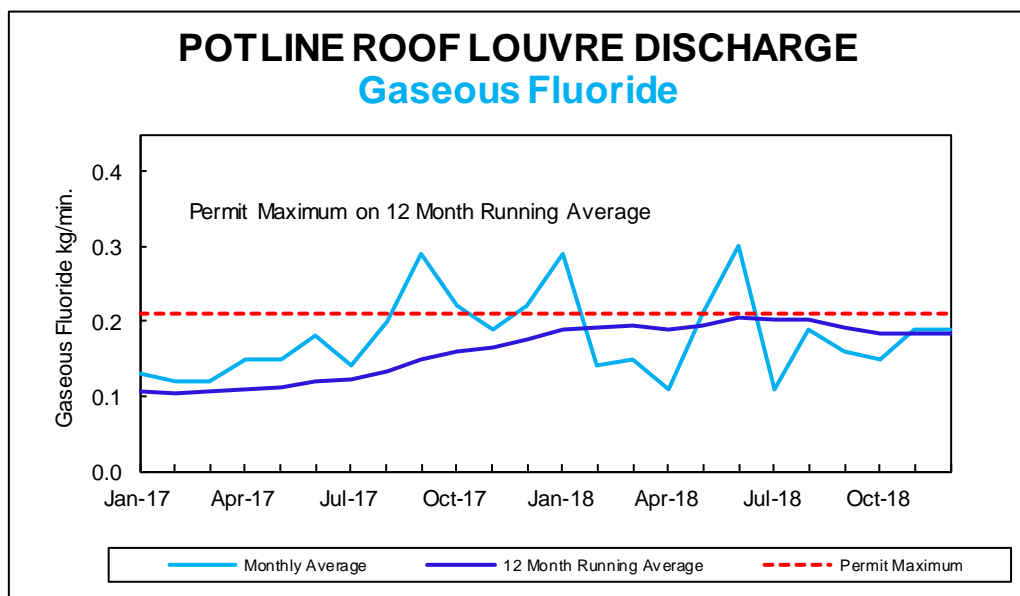
The following graph shows the annual average Potline roof louvre total particulate discharge.



Gaseous fluoride

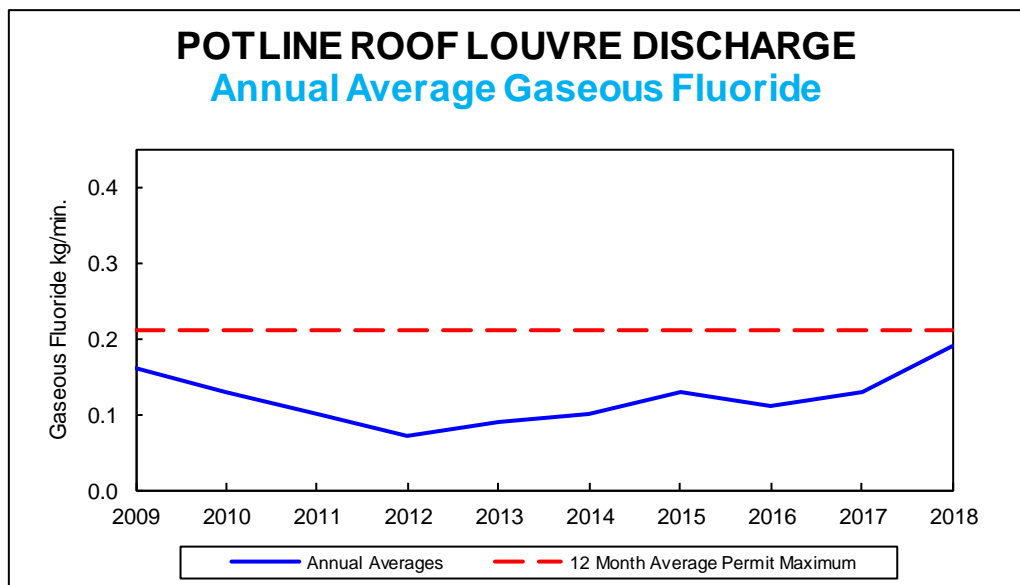
Permit: 12 month running average not to exceed 0.21 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre gaseous fluoride discharge during 2017 and 2018.

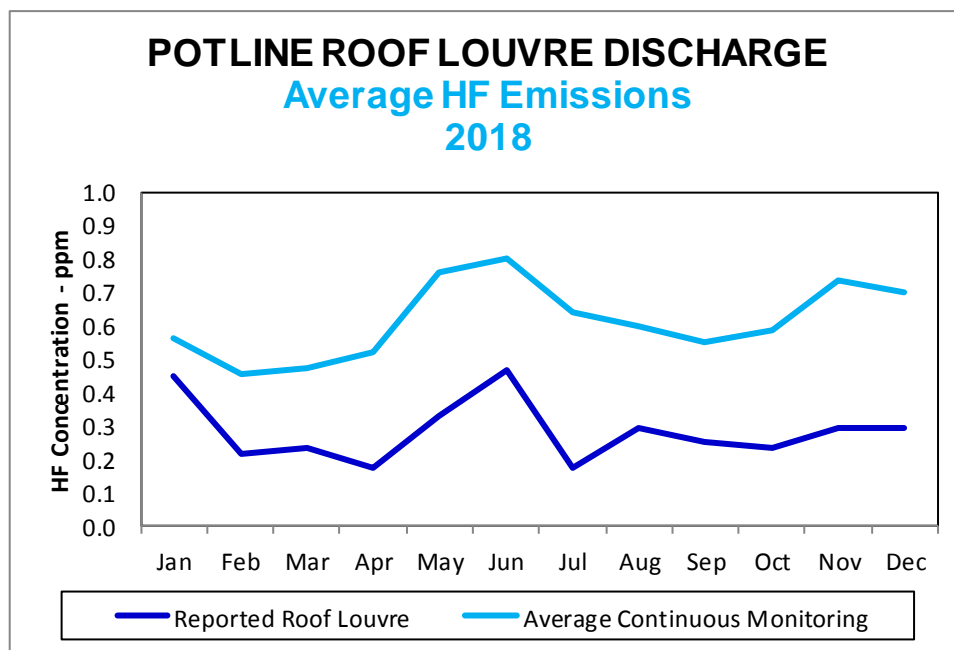


Potline Roof Louvre Discharges, continued

The following graph shows the annual average Potline roof louvre gaseous fluoride discharge.



The following graph shows the reported Potline Roof Louvre gaseous fluoride emissions in comparison to the Boreal continuous monitoring results.



Note:

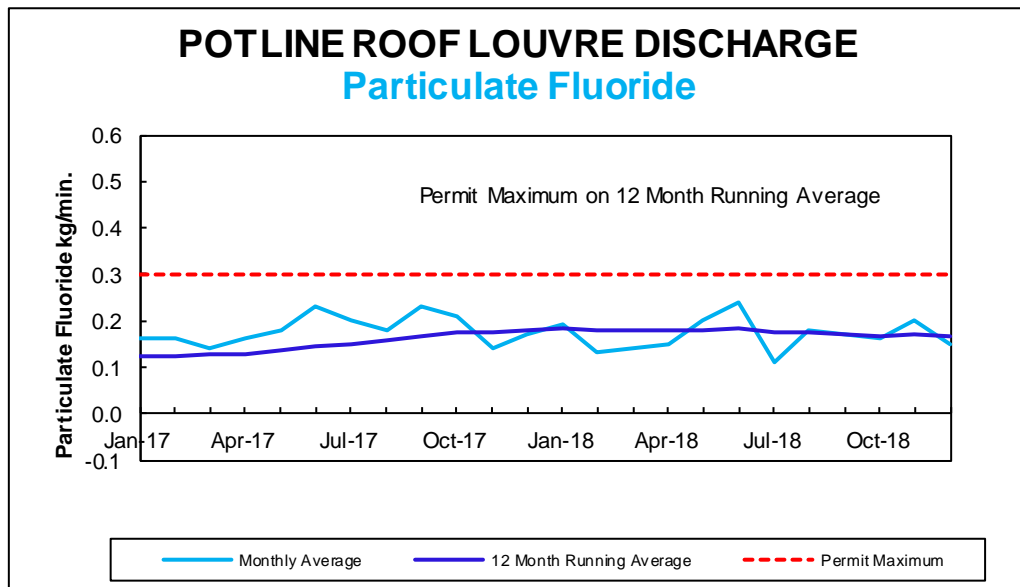
Both measurement systems trend each other consistently. The difference in the reported roof louvre emissions and the continuous monitoring instrument data (Boreal) is consistent with the difference measured between these two systems since the Boreal instruments were installed in 2008.

Potline Roof Louvre Discharges, continued

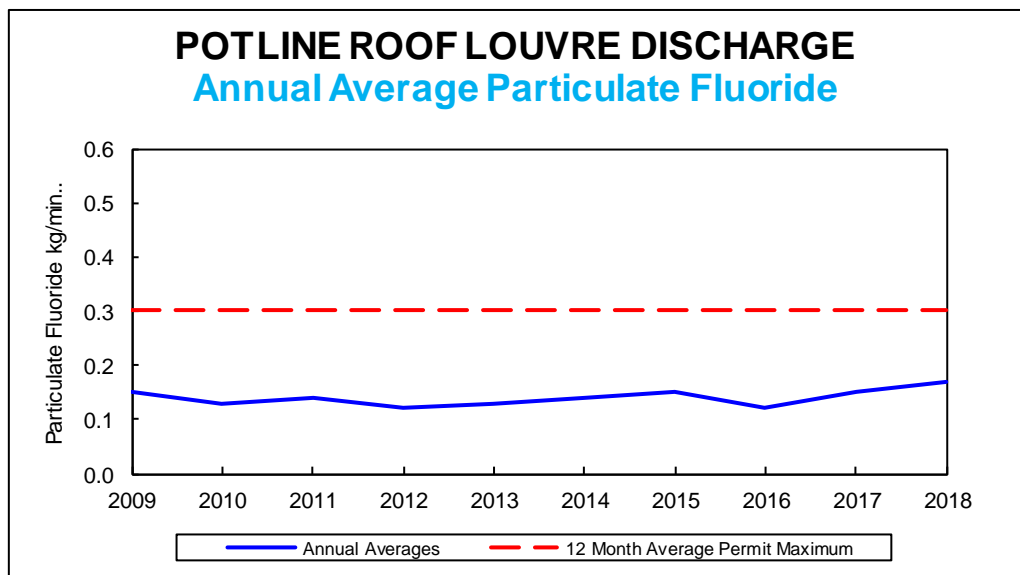
Particulate fluoride

Permit: 12 month running average not to exceed 0.30 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre particulate fluoride discharge during 2017 and 2018.



The following graph shows the annual average data for Potline roof louvre particulate fluoride discharge.

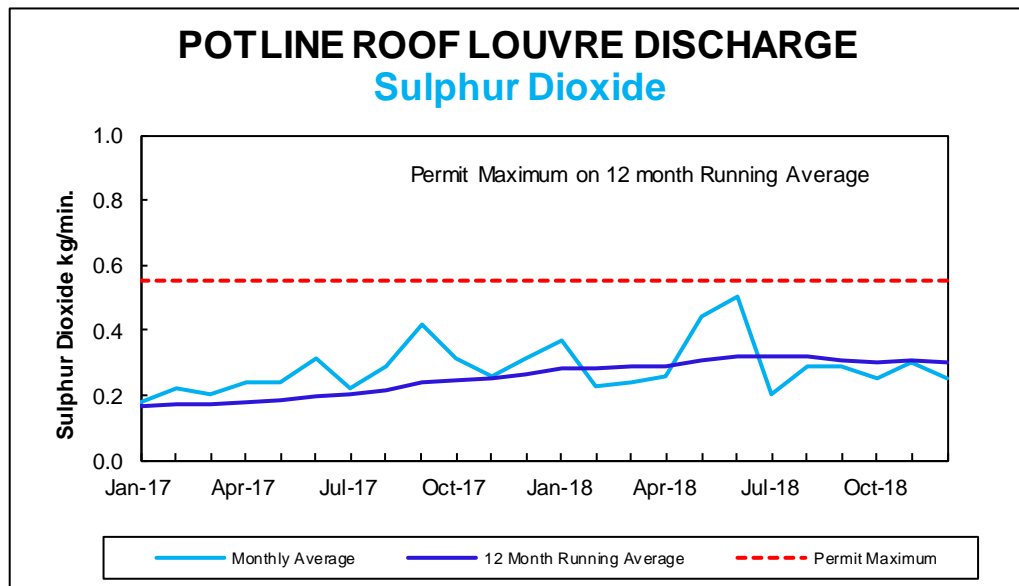


Potline Roof Louvre Discharges, continued

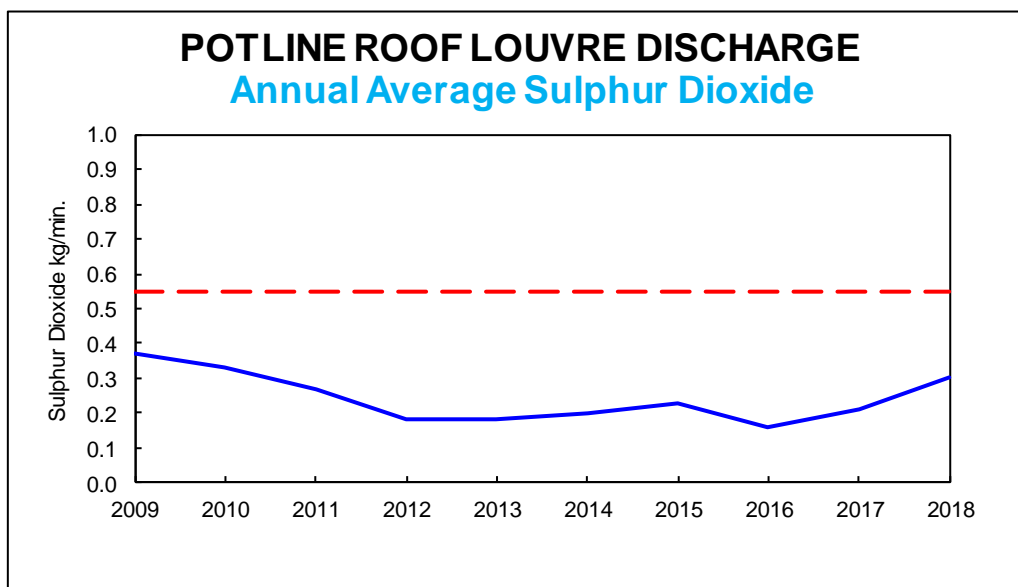
Sulphur dioxide

Permit: 12 month running average not to exceed 0.55 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre sulphur dioxide discharge during 2017 and 2018.



The following graph shows the annual average Potline roof louvre sulphur dioxide discharge.



Potline Roof Louvre Discharges, continued

Comments

The discharge of total particulate, sulphur dioxide, and particulate fluoride and gaseous fluoride from the Potline roof louvres were within permit limits for 2018.

High Gaseous Fluoride emission levels are still being closely monitored. Vigilant work by Reduction Line Process Controllers on ensuring adequate draft is continuously applied to reduction cells continues to be a high priority. Investigations into other causes for these high emissions are continuing.

Line 4 remained closed for most of 2018 with the Gas Flow Rate for Roof Louvre emissions remaining at 720,800 Sm³/min. Re-commissioning of Line 4 reduction cells commenced in October and continued through to December. As of 1st January 2019 all 44 cells had been re-started. Recalculation of emissions through roof louvres to take into account Line 4 cells now operating will be applied from January 2019 onwards.

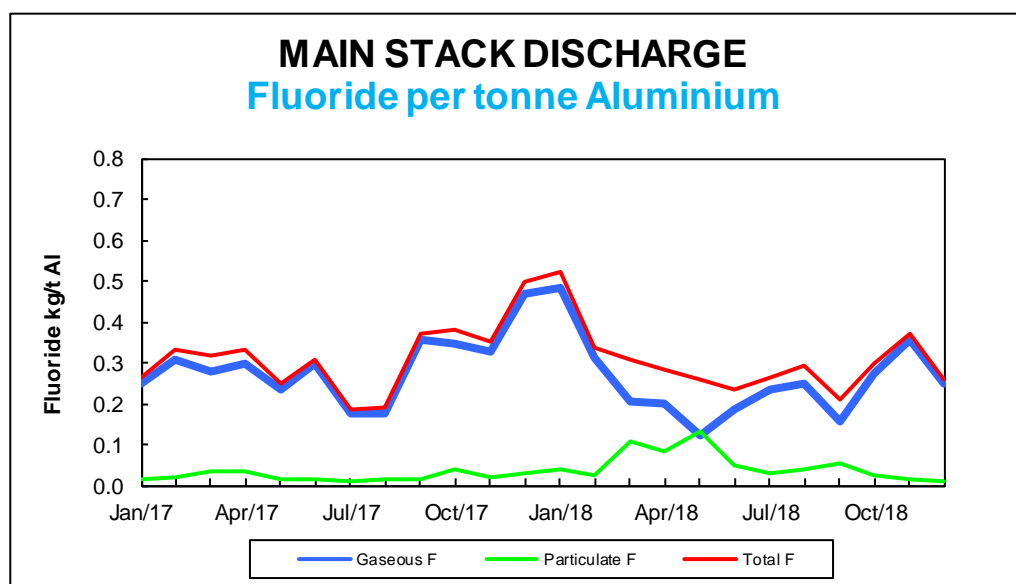
Fluoride Discharges

Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2018.

Parameter	Units	2018	Maximum for any month
Main Stack			
• Gaseous fluoride	kg/t Al	0.25	0.48
• Particulate fluoride	kg/t Al	0.05	0.13
• Total fluoride	kg/t Al	0.30	0.52
Reduction Line Roof Louvres			
• Gaseous fluoride	kg/t Al	0.28	0.47
• Particulate fluoride	kg/t Al	0.26	0.38
• Total fluoride	kg/t Al	0.54	0.84
Plant			
• Gaseous fluoride	kg/t Al	0.53	0.93
• Particulate fluoride	kg/t Al	0.31	0.44
• Total fluoride	kg/t Al	0.84	1.27

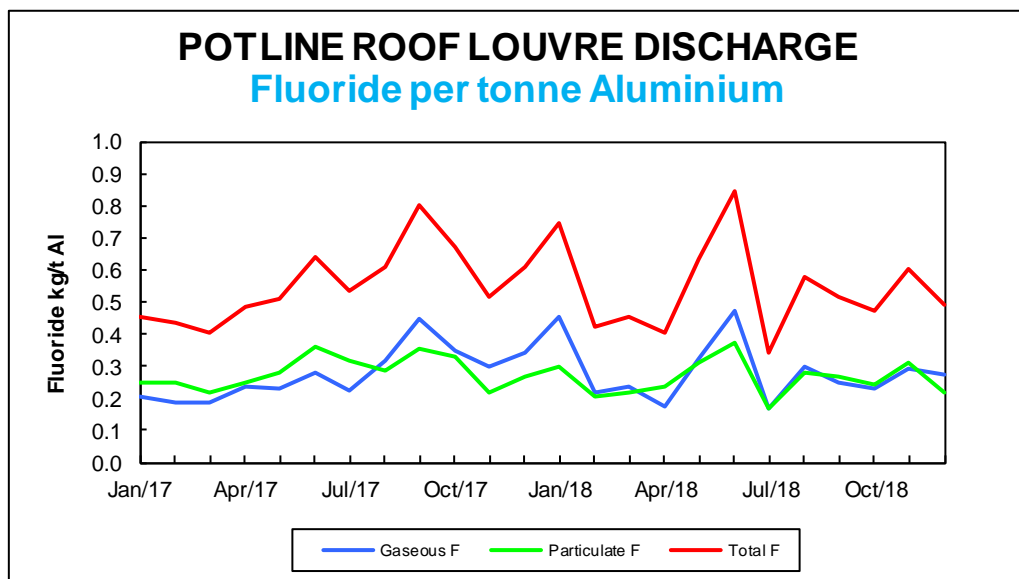
The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2017 and 2018.



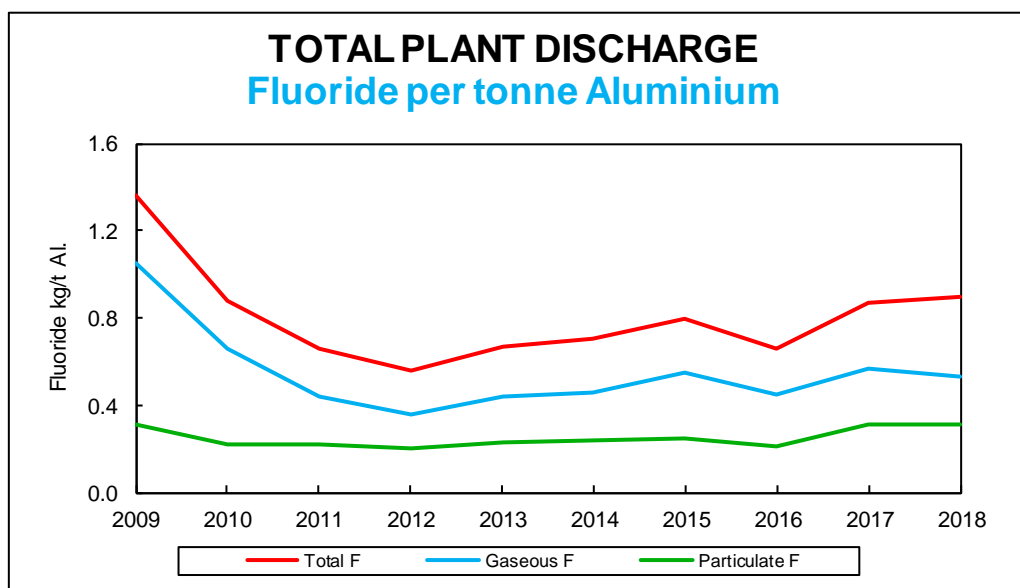
Fluoride Discharges, continued

Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2017 and 2018.



The following graph shows the average total plant fluoride per tonne aluminium for the last 10 years.



Comments

The annual total fluoride discharge rate per tonne of aluminium produced, from the plant for 2018, remains similar to 2017.

Since 2012 a trend of increased fluoride discharge is observed.

Dust Collector Discharges

Permit Conditions:

Shall not exceed

250 mg/Sm³

Action shall be taken if concentration exceeds

100 mg/Sm³.

Monitoring results

The table below shows the Dust Collector monitoring results for 2018. The table reflects the Air Discharge Permit standards, which came into effect in June 2006. The Permit requires that all dust collectors be tested once every two years.

Dust Collector	Date	Total Particulate discharge (mg/Sm ³)	Flow Rate (Sm ³ /min)
Wharf Corner test 1	3/1/18	1	20
Wharf Corner test 2	3/1/18	1	19
Day Bin 3	9/2/18	2	32
East / East	20/2/18	25	24
G.C. Ball Mill test 1	2/5/18	6	20
G.C. Ball Mill test 2	3/5/18	4	21
G C Nusiance	7/5/18	16	22
CR Induction Furnace	18/5/18	25	18
T1 Tower	5/7/18	2	20
West Reclaim	10/7/18	0	17
T1 A	30/7/18	5	13
Day Bin 1	6/9/18	0	21
Flakt test 1	13/9/18	37	25

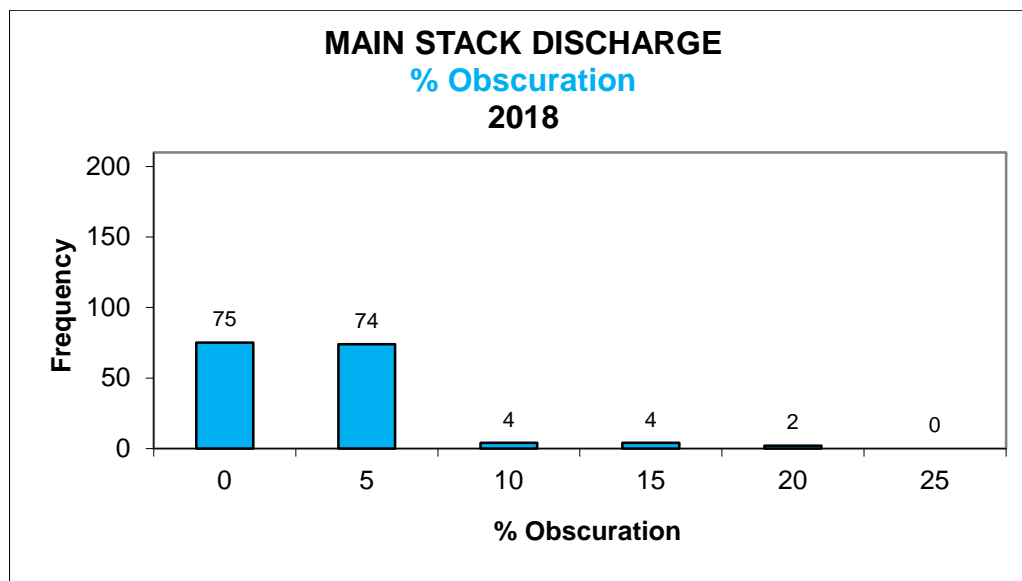
Dust Collector	Date	Total Particulate discharge (mg/Sm ³)	Flow Rate (Sm ³ /min)
Flakt test 2	13/9/18	14	25
Lab Bath Grinder	2/11/18	27	24

Comments

All dust collectors tested during 2018, were found to be within the consent level of 250 mg/Sm³.

Main Stack Smoke Discharges

Main Stack smoke discharges were determined by visual observations using the standard Ringlemann chart. The following graph summarises the observations recorded during 2018.



It must be noted that there is no data for January and February 2018 due to the loss of the field record book. For the remaining 10 months, the majority of observations were in the 1 to 5% range. Only on four occasions was an observation in the 10% range made and on four occasions an observation in the 15% range.

Sulphur Content of Raw Materials and Fuels

The following table shows the maximum, minimum, and average sulphur content of raw materials and fuels delivered to the smelter during 2018.

	Units	Permit Maximum	2018 Annual Average	2018 Maximum	2018 Minimum
Petroleum Coke	%	4	2.68	3.09	2.36
Pitch	%	1	0.53	0.70	0.40
Heavy Fuel Oil	%	3.5	2.44	2.61	2.26

Comments

All shipments of raw materials and fuels during 2018 met the permit standards for sulphur content.

The average sulphur content of the Petroleum Coke, Pitch and Heavy Fuel Oil have marginally increased from 2017.

High sulphur and low sulphur coke shipments are blended to control the final sulphur content in anodes. This will help control sulphur emissions from main stack and roof louvres.

Part C - Dispersion Conditions

Introduction

This chapter covers the monitoring of meteorological conditions at the Tiwai Point meteorological station. These conditions effect the dispersion of discharges into air from the smelter. The data includes:

- the distribution of wind strength,
- the distribution of wind direction, and
- rainfall.

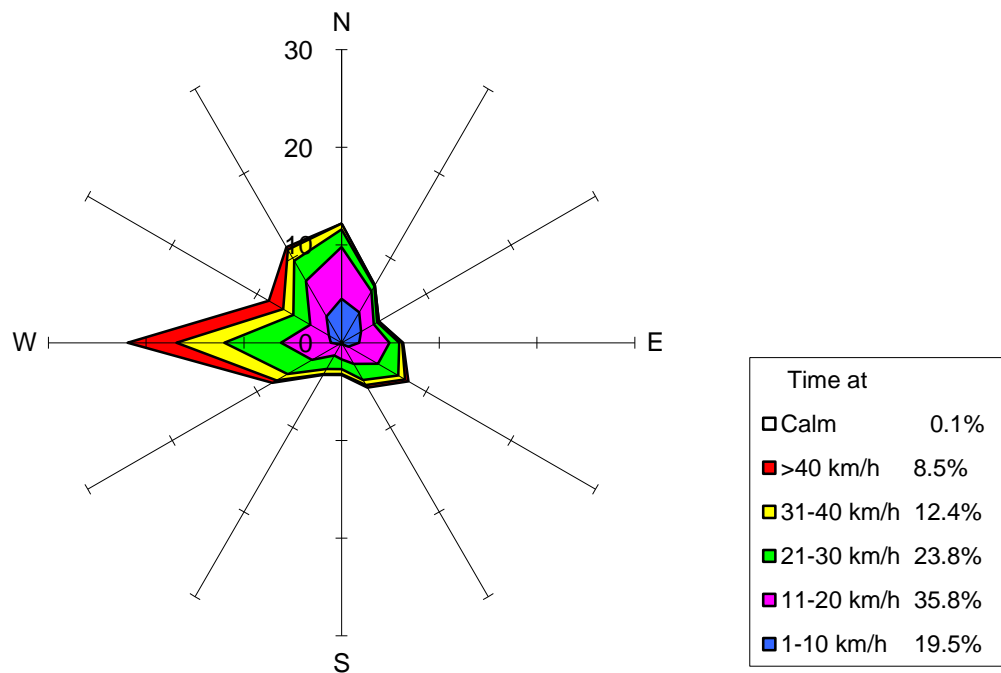
Meteorological Conditions

The following table shows the predominant winds and total rainfall recorded for each month during 2018.

Month	Predominant Wind Direction	Rainfall (mm)
January	West and South - East	20
February	West	125
March	Moderate from all directions	94
April	West	153
May	West and North - West	129
June	North	57
July	North	117
August	North	45
September	West and North	40
October	West	54
November	West and South - East	111
December	West	42

Total rainfall for the year is 987mm. The five year running average is 923mm. The long term annual average is 1069mm of rainfall.

**New Zealand Aluminium Smelters Limited - Tiwai Point
Mean Wind Frequency (%) of Surface Wind Directions
Period: 2018 Annual**



Comments

The mean wind frequency diagram shows that the 2018 wind pattern was dominated by westerly winds with some moderate winds from the north.

Dispersion conditions are in general similar to the previous 2 years.

Total rainfall for 2018 is marginally higher than the five year running average and slightly lower than the annual long term average.

Part D - Ambient Air

Introduction

This chapter covers the monitoring for gaseous and particulate fluorides in ambient air at two monitoring sites. The No 1 Bore site is monitored biannually and is usually done for the months of March and October. The 1km Hut site is located on Rio Tinto freehold land and is sampled on a weekly basis.

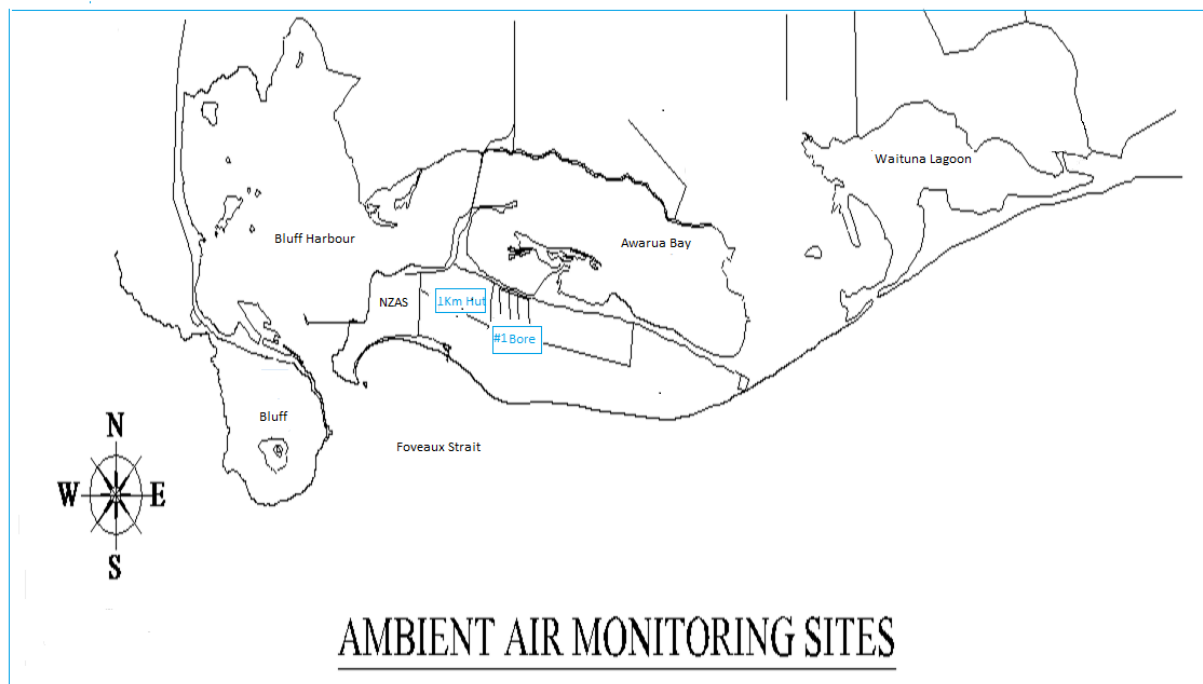
Permit Limits

No limits apply to the 1km Hut site for particulate and gaseous fluoride. A gaseous fluoride limit applies to the No. 1 Bore Hut site.

The sampling and analysis method used is referenced to AS 3580.1991 and has a detection limit of $0.1 \mu\text{g}/\text{m}^3$.

Site Locations

The locations of the monitoring sites are shown in following map.



Ambient Air at 1 Kilometre Hut

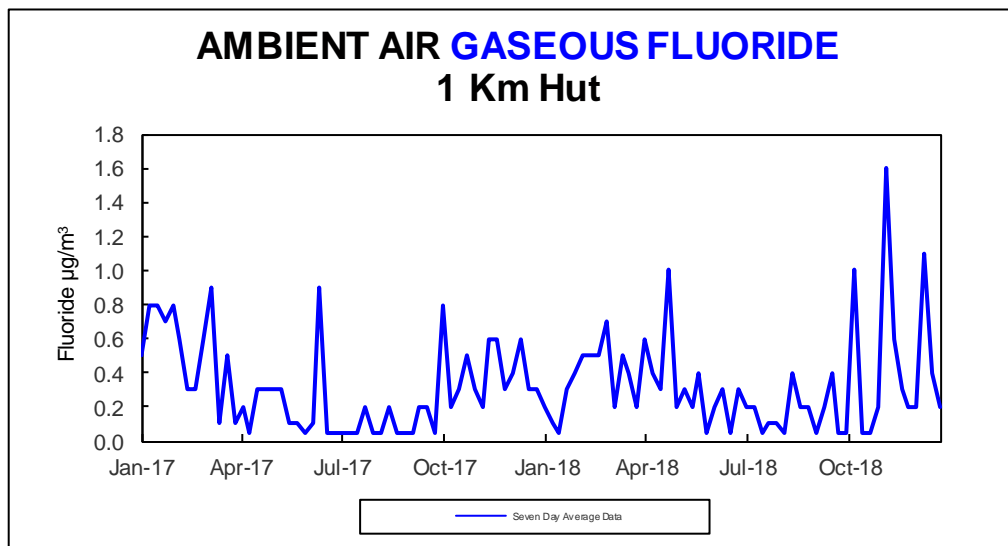
Monitoring results

The following table summarises the monitoring results during 2017 and 2018. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	2017	2018
Gaseous Fluoride Concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.90	1.60
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.70	0.60
• Annual average	$\mu\text{g}/\text{m}^3$	0.31	0.34
Particulate fluoride concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.90	0.90
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.60	0.30
• Annual average	$\mu\text{g}/\text{m}^3$	0.19	0.16

Gaseous fluoride

The following graph shows the seven-day average gaseous fluoride results for this site.

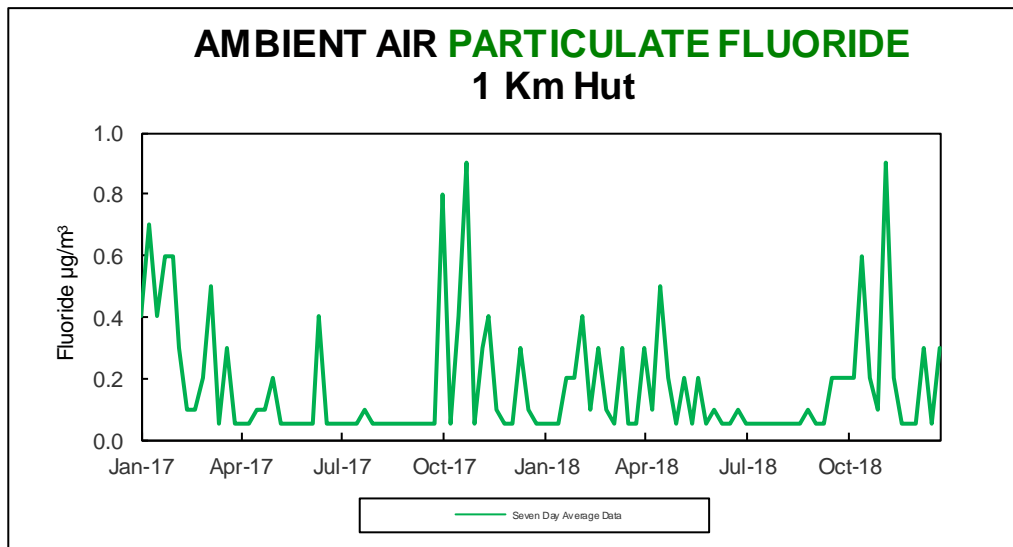


Note: Concentrations $< 0.1 \mu\text{g}/\text{m}^3$ are plotted as $0.05 \mu\text{g}/\text{m}^3$

Ambient Air at 1 Kilometre Hut, continued

Particulate Fluoride

The following graph shows the seven-day average particulate fluoride results for this site.



Note: Concentrations $< 0.1 \mu\text{g}/\text{m}^3$ are plotted as $0.05 \mu\text{g}/\text{m}^3$

Comments

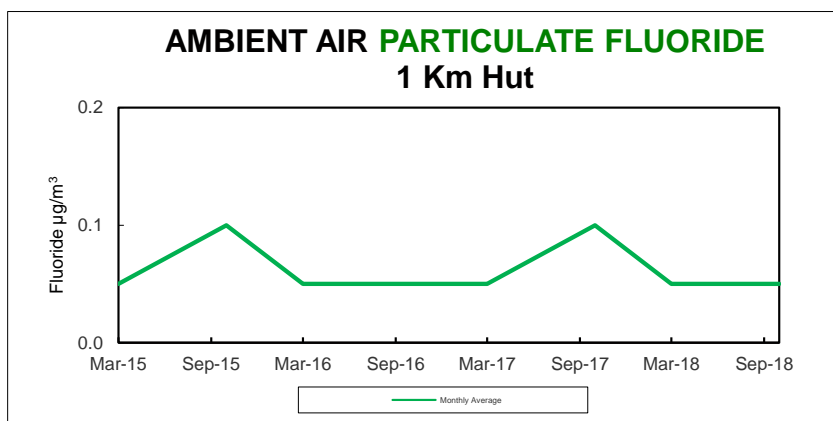
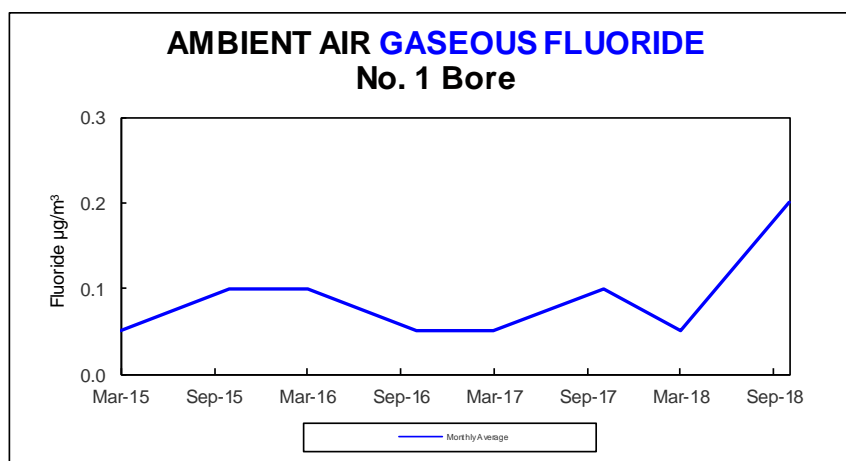
Concentrations of gaseous & particulate fluoride were within the normal range for the 1km hut site throughout 2018. Some elevated trends in concentrations correlate to our increase in roof louvre emissions.

Ambient Air at No. 1 Bore on Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2017 and 2018 for the No. 1 Bore site located on Tiwai Peninsula.

Parameter	Units	Limit	2017	2018
Gaseous Fluoride Concentration				
• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	0.13
• Max Monthly		0.5	0.10	0.20
Particulate fluoride concentration				
• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1



Comments

Gaseous concentrations are at a higher level compared to those previously reported but still well within our consent limit

Particulate concentrations have remained the same at this site.

Part E - Atmospheric Deposition

Introduction

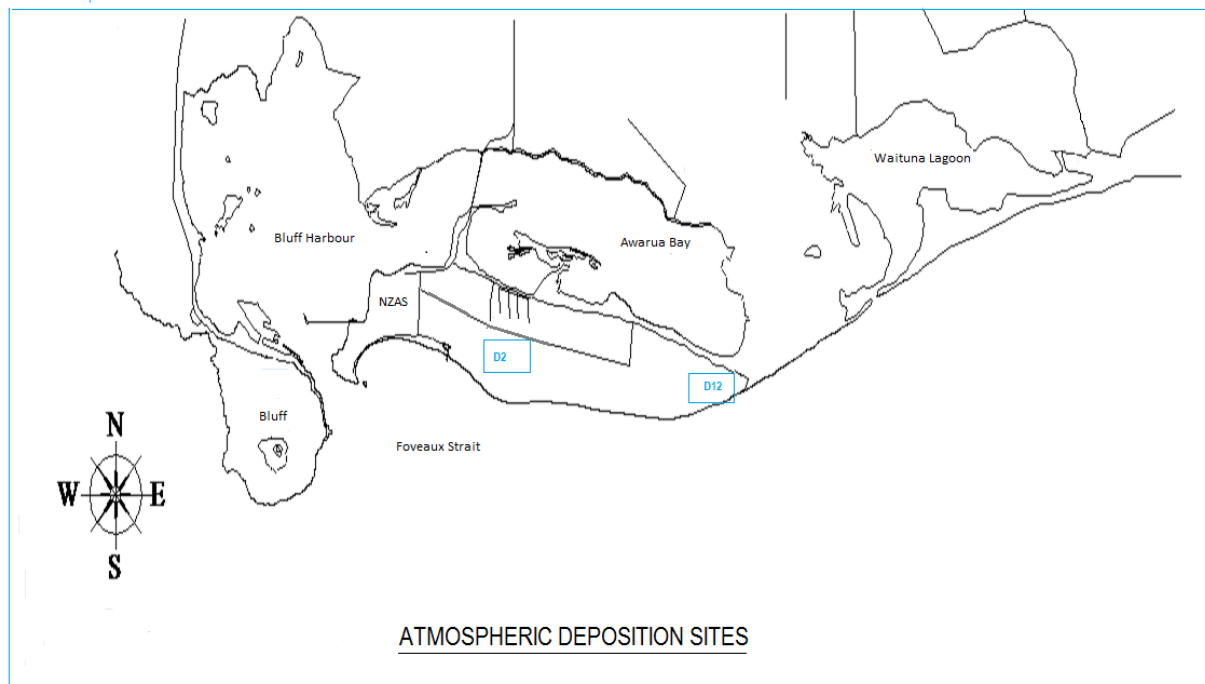
This chapter covers the monitoring of atmospheric deposition at two monitoring sites. Monitoring was carried out monthly until the end of 2014. During the subsequent years monitoring has been biannually and is usually done for the months of March & October.

Permit Guidelines

No guidelines are applicable to the two monitoring sites that are located on Tiwai Peninsula.

Site Locations

The locations of the monitoring sites are shown in the following map.



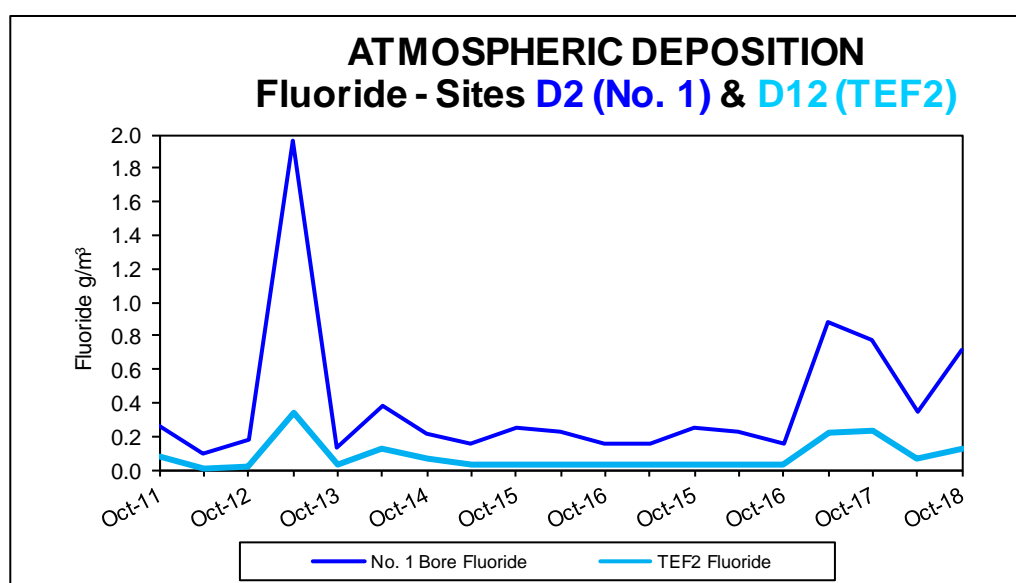
Atmospheric Deposition Monitoring Results

Fluoride Deposition

The fluoride atmospheric deposition during 2018 is summarised in the following table.

Site	Units	2017 Average	2018 Average
D2. No.1 Bore ¹	gm ⁻³	0.83	0.53
D12 TEF2 ¹	gm ⁻³	0.23	0.10

The following graph shows the last 10 years results for Sites D2 and D12.



Comments

Fluoride levels at both sites show a drop during March this year due to an above long term average rainfall of 94mm and low roof louvre emissions. Elevated Fluoride concentrations during October reflect very dry conditions with only 54mm of rain, half the long term average, as well as higher roof louvre emissions.

Part F - Fluoride in Ungrazed Grass

Introduction

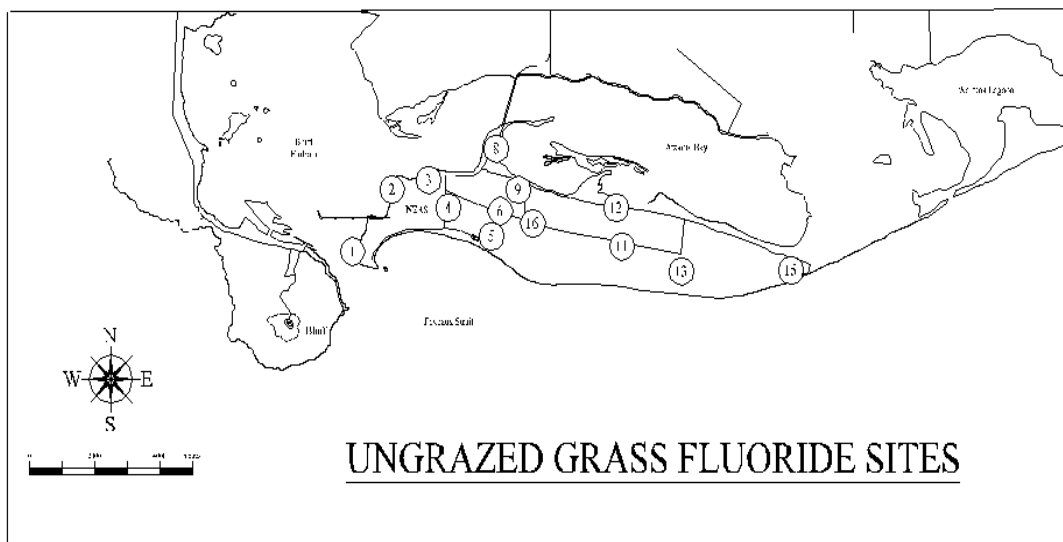
This chapter covers the monitoring of fluoride in ungrazed grasses at 13 monitoring sites located on Tiwai Peninsula. This monitoring is carried out biannually, usually in March & October.

Permit Guidelines

There are no guidelines since changes were made to the Discharge to Air Consent in December 2014.

Site Locations

The ungrazed grass monitoring sites are shown on the following map.



Ungrazed Grass Monitoring Results

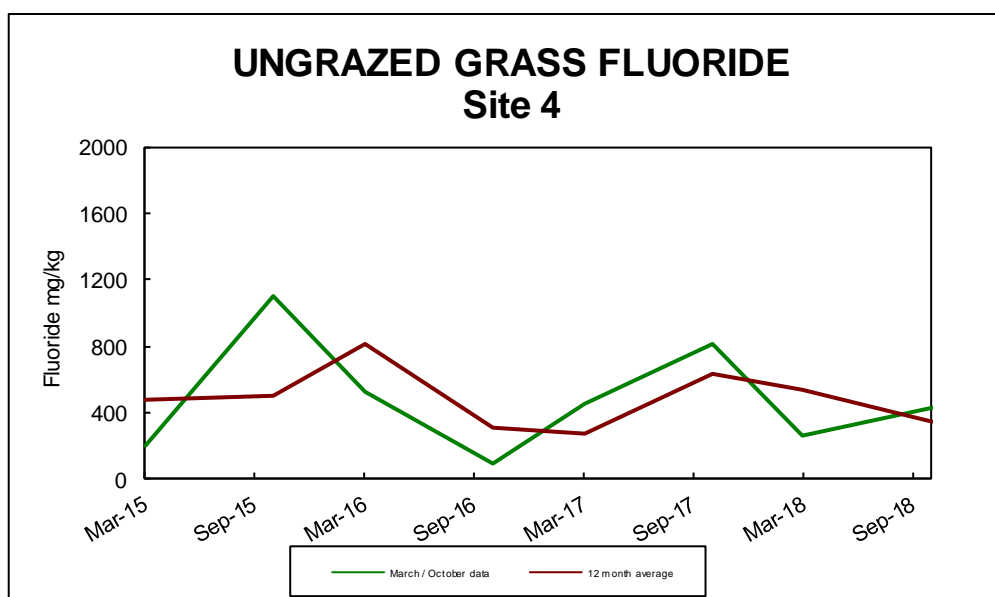
Annual average fluoride concentrations.

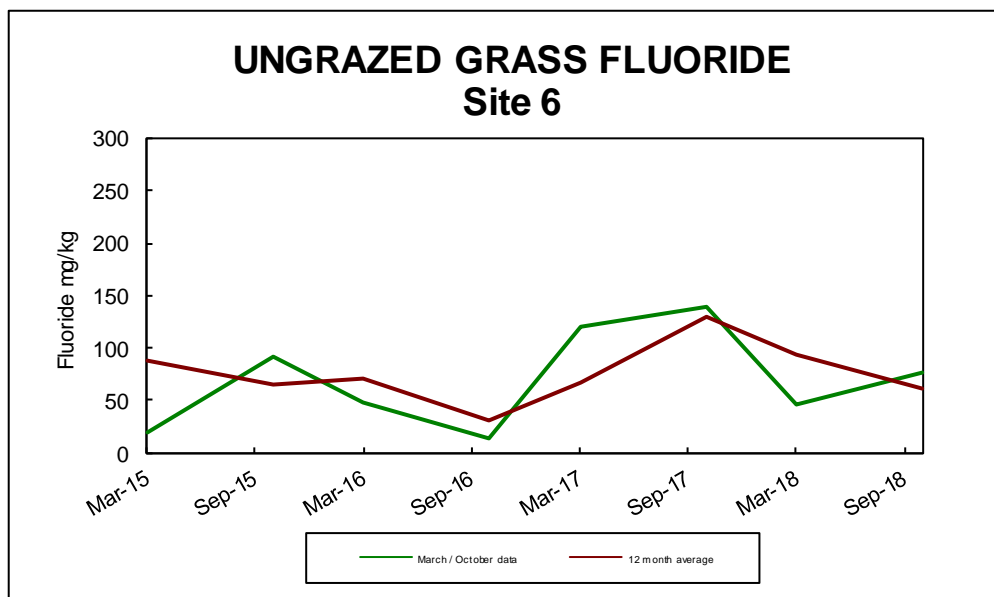
The following table summarises the monitoring results of ungrazed vegetation sites for 2017 and 2018.

Site	2017 Ave Fluoride mg/kg	2018 Ave Fluoride mg/kg
1	12	12
2	86	61
3	76	43
4	630	345
5	20	25
6	130	61
8	22	13
9	36	15
11	12	18
12	22	10
13	14	7
15	12	8
16	27	23

Note

In the 2017 annual report the grass Fluoride concentration for Site 3 was incorrectly reported at 0. This has been rectified in the table above.





Comments

The average fluoride levels for each site are similar to concentration levels measured in previous years. As the graphs of some historical data show, grass Fluoride tends to fluctuate from year to year mostly being influenced by the wind and rain elements for that year.

Part I - Water Take

Introduction

Water Take from the aquifer on Tiwai Peninsula is covered by Consent Number 202958 issued by Southland Regional Council on the 12th September 2005.

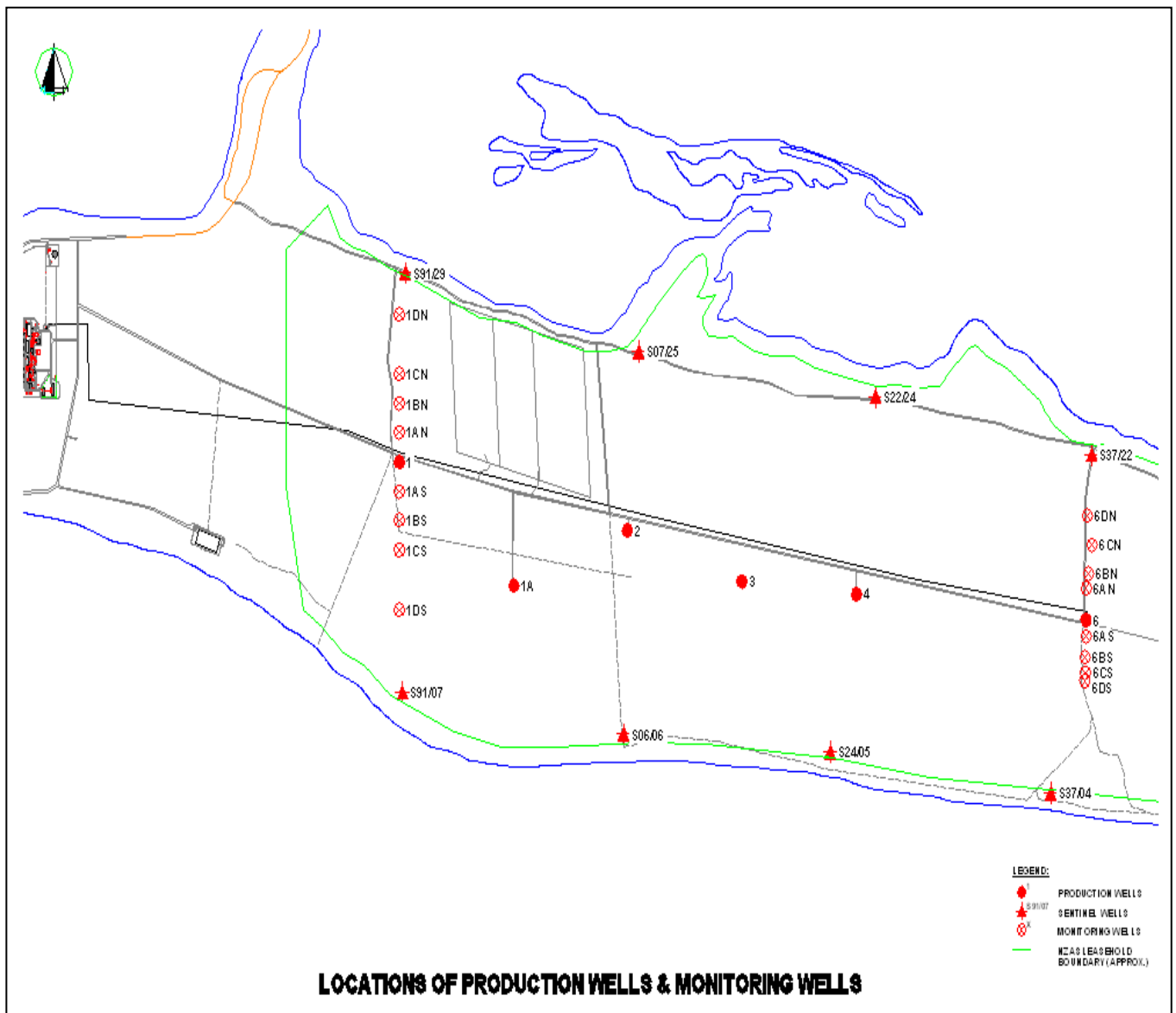
Permit Conditions

Total abstraction rate not to exceed 4,546 m³/day.

Results of monitoring to be reported to the Council by the 31st March each year.

Site Locations

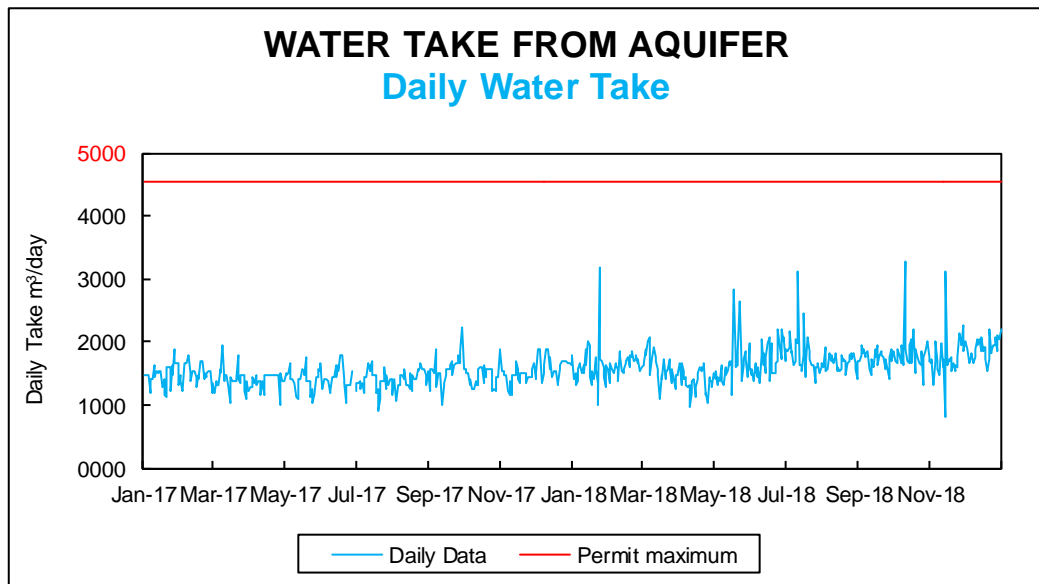
The locations of the Production and Monitoring Water Wells are shown in the following map.



Water Take from Aquifer

Monitoring Results

The total volume of water taken from the aquifer was recorded daily until early December 2012. Due to organisational restructuring at that time, the readings from then on were not carried out in the weekends or public holidays and an average reading was reported for those days. From July 2017 onwards the data is now captured automatically on a daily basis. The data is displayed in the graph below.



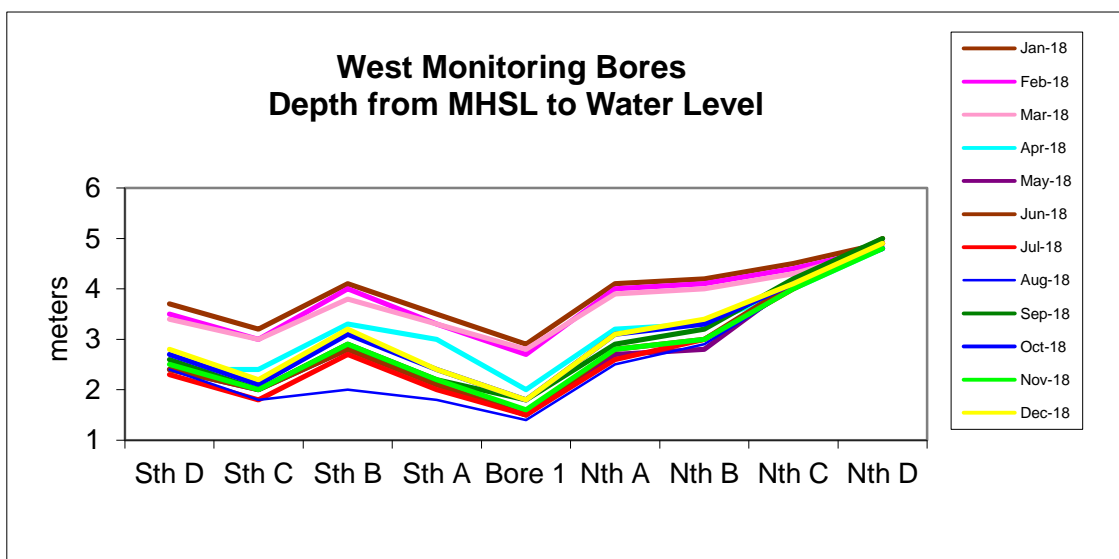
The table below summarises the daily data on a monthly basis.

Daily Water Take		
Date	Average m ³ /day	Maximum m ³ /day
Jan-18	1611	3187
Feb-18	1638	1849
Mar-18	1602	2069
Apr-18	1384	1677
May-18	1635	2843
Jun-18	1718	2189
Jul-18	1792	3132
Aug-18	1676	1902
Sep-18	1732	1933
Oct-18	1824	3283
Nov-18	1755	3118
Dec-18	1893	2205

Water Take from Aquifer, continued

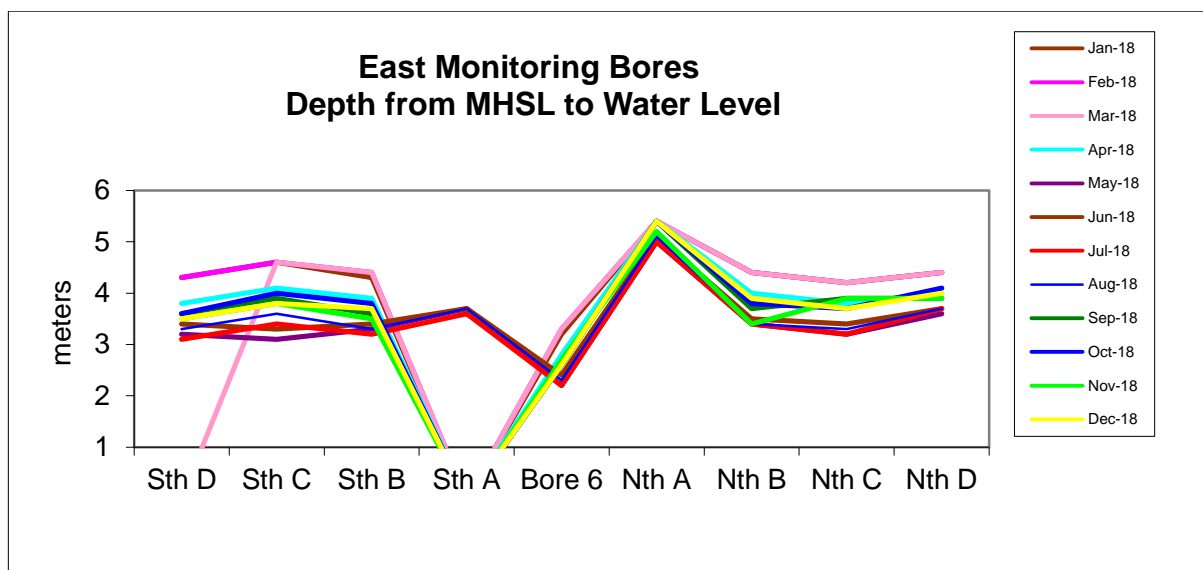
The following tables and graphs show the water level for each monitoring bore around production bores 1 and 6, measured while pumping from the production bores.

West Monitoring Bore Water Levels (from Mean High Sea Level in metres) <i>Total well depth in Italics</i>									
Date	South				Bore 1	North			
	D	C	B	A		A	B	C	D
	<i>5.64</i>	<i>5.50</i>	<i>5.50</i>	<i>4.62</i>	<i>16.4</i>	<i>5.32</i>	<i>5.30</i>	<i>5.55</i>	<i>5.27</i>
Jan-18	3.70	3.20	4.10	3.50	2.90	4.10	4.20	4.50	4.90
Feb-18	3.50	3.00	4.00	3.30	2.70	4.00	4.10	4.40	4.80
Mar-18	3.40	3.00	3.80	3.30	2.80	3.90	4.00	4.30	4.80
Apr-18	2.40	2.40	3.30	3.00	2.00	3.20	3.30	4.00	4.80
May-18	2.40	2.00	2.80	2.10	1.50	2.70	2.80	4.10	4.90
Jun-18	2.40	2.00	2.80	2.10	1.50	2.80	3.00	4.10	5.00
Jul-18	2.30	1.80	2.70	2.00	1.50	2.60	3.00	4.00	4.90
Aug-18	2.40	1.80	2.00	1.80	1.40	2.50	2.90	4.00	4.90
Sep-18	2.60	2.00	2.90	2.20	1.80	2.90	3.20	4.20	5.00
Oct-18	2.70	2.10	3.10	2.40	1.80	3.10	3.30	4.10	4.80
Nov-18	2.50	2.00	2.90	2.20	1.60	2.80	3.00	4.00	4.80
Dec-18	2.80	2.20	3.20	2.40	1.80	3.10	3.40	4.10	4.90



Water Take from Aquifer, continued

East Monitoring Bore Water Levels (from Mean High Sea Level in metres) <i>Total well depth in Italics</i>									
Date	South				Bore 6	North			
	D	C	B	A		A	B	C	D
	<i>4.32</i>	<i>5.35</i>	<i>5.79</i>	<i>3.82</i>	<i>8.6</i>	<i>5.46</i>	<i>5.4</i>	<i>5.45</i>	<i>5.5</i>
Jan-18	4.30	4.60	4.30	dry	3.20	5.40	4.40	4.20	4.40
Feb-18	4.30	4.60	4.40	dry	3.30	5.40	4.40	4.20	4.40
Mar-18	dry	4.60	4.40	dry	3.30	5.40	4.40	4.20	4.40
Apr-18	3.80	4.10	3.90	dry	2.80	5.40	4.00	3.80	4.00
May-18	3.20	3.10	3.30	3.70	2.20	5.00	3.40	3.20	3.60
Jun-18	3.40	3.30	3.40	3.70	2.40	5.10	3.50	3.40	3.70
Jul-18	3.10	3.40	3.20	3.60	2.20	5.00	3.40	3.20	3.70
Aug-18	3.30	3.60	3.30	3.70	2.30	5.10	3.40	3.30	3.70
Sep-18	3.60	3.90	3.60	dry	2.60	5.40	3.70	3.90	3.90
Oct-18	3.60	4.00	3.80	dry	2.60	5.40	3.80	3.70	4.10
Nov-18	3.50	3.80	3.50	dry	2.70	5.20	3.40	3.90	3.90
Dec-18	3.50	3.80	3.70	dry	2.60	5.40	3.90	3.70	4.00



Comments

Water levels in the monitoring bores have not changed significantly during 2018. Bore South A was dry for 8 out of the 12 months as reflected in the graph above compared to being dry for the whole 12 months in 2017.

Part J - Liquid Discharges and Their Effects

Introduction

Liquid discharges from the smelter are covered by Discharge Permits issued by the Southland Regional Council. These permits commenced in June 2006.

This chapter gives details of the monitoring results for each permit.

Permit Limits

The following table shows the permit limits applying to the discharges to water and onto land.

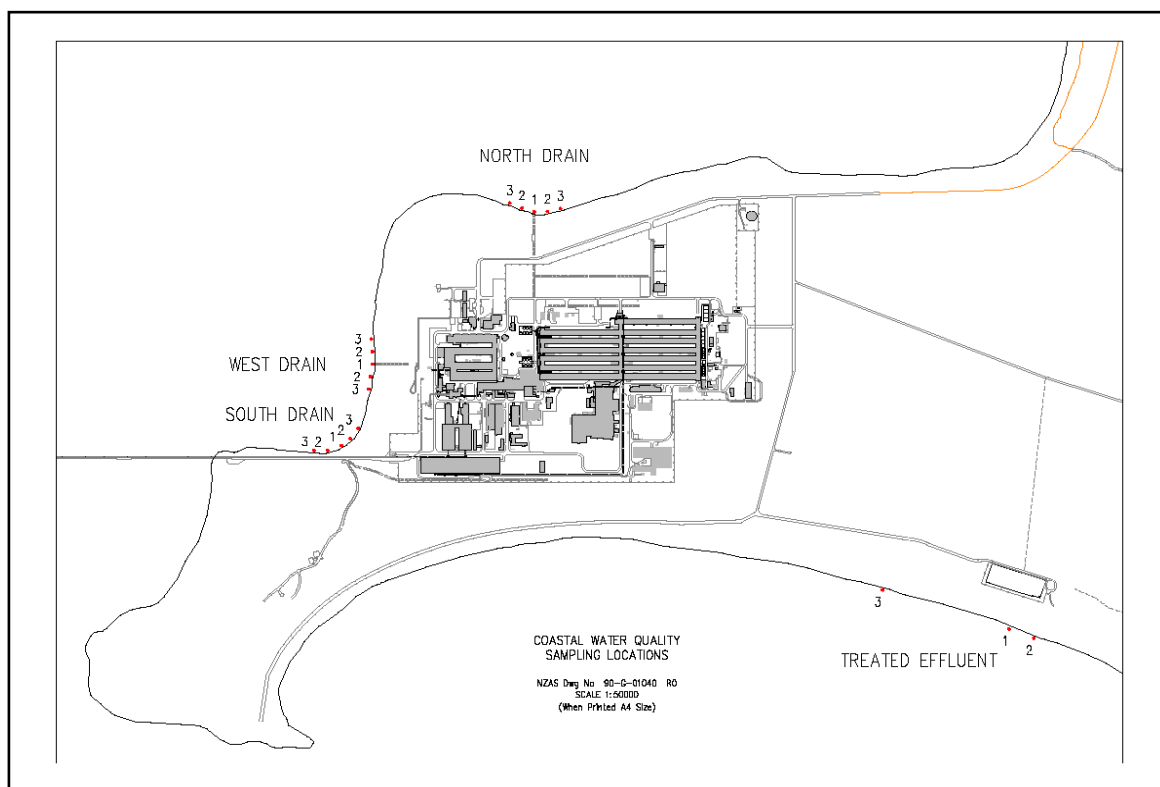
	Units	Limit
North, South, and West Drain		
• Quarterly average total suspended solids	g/m ³	30
Treated effluent		
• Maximum daily discharge	m ³ /day	140
• Total suspended solids	g/m ³	100
• Free cyanide	g/m ³	20
Treated sewage		
• Maximum daily flow	m ³ /day	295
• Biochemical oxygen demand	kg/day	18
• Total suspended solids	kg/day	8

The following permit limits apply to coastal water monitoring sites:

- The natural temperature of the water shall not be changed by more than 3°C and the natural temperature of the water shall not exceed 25°C;
- Any pH change and/or any discharge of a contaminant into the water or water into water or onto the seabed shall not result in a loss of biological diversity or a change in community composition;
- The concentration of dissolved oxygen shall exceed 80% of saturation concentration;
- Fish or other aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants;
- There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water;
- Aquatic life is not adversely affected by the taking of any physical, chemical or biological constituent from the water;
- Visual clarity shall not be diminished by more than 20%;
- The water shall not be rendered unsuitable for bathing by the presence of contaminants;
- The water shall not be altered in those characteristics which have a direct bearing upon cultural or spiritual values;
- The quarterly average fluoride concentration at drain coastal water monitoring sites shall not exceed 2g/m³ based on the results of representative samples collected each week; and
- The fluoride concentration in any representative drain coastal water monitoring sample collected weekly shall not exceed 5g/m³.

Site Locations

The locations of liquid discharges and their monitoring sites are shown in the following map.



Discharge Monitoring

The discharges from the North, South and West Drains are sampled once each week. The temperature of each discharge is measured once each year as part of the annual seawater quality monitoring survey.

The discharge of treated sewage is sampled over a 24 hour period once each month.

The discharge of treated effluent from the cathode pad treatment facility is sampled once per batch of treated effluent. A pre discharge sample is taken to check for suspended solids concentration in the effluent, prior to the actual sample being taken during discharge.

Coastal Water Monitoring

Coastal water quality is determined by comparing the results of monitoring at coastal water monitoring sites with the results at control sites. The coastal water monitoring sites are chosen to monitor the effects of discharges on coastal waters. The control sites are chosen to best represent the background coastal water quality.

Coastal water is monitored for pH, conductivity, fluoride, visible oil and visual change each time a drain discharge is sampled.

Additional coastal water monitoring for drain discharges is undertaken annually.

Annual coastal water monitoring is undertaken for the discharge of treated effluent.

Sewage Land Disposal Area Groundwater Monitoring

Groundwater near the sewage land disposal area is monitored by sampling from one upstream bore north of the disposal area, and one downstream bore south of the disposal area.

Monitoring is carried out at about six monthly intervals.

North Drain Discharges

Introduction

Discharges from the North Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the North Drain discharge monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Total Suspended solids	g/m ³		11.8	15.6
• Maximum Quarterly Average	g/m ³	30	13.9	17.9
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			7.7	7.5
Fluoride	g/m ³		5.8	7.7
Conductivity	µS/cm		45311	42907

Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Fluoride	g/m ³		1.4	1.4
• Maximum Quarterly Average	g/m ³	2	1.4	1.5
• No. of Times Quarterly Average >2.0 g/m ³		0	0	0
• Maximum Individual Sample	g/m ³	5	3.3	3.3
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51225	51113
Visible Oil - No. of times Observed			0	0

North Drain Discharges continued.

Control Site water monitoring results

The following table summarises the North Drain weekly control site water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Result	2018 Result
Fluoride	g/m ³		1.3	1.3
• Maximum Quarterly Average	g/m ³		1.3	1.5
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.4	1.4
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51261	51256
Visible Oil - No. of times Observed			0	0

Annual Monitoring results

The following table summarises the North Drain annual coastal water monitoring results during 2018 and shows a comparison with 2017 results.

Site	Parameter	Units	Limit	2017	2018
Discharge	Temperature	°C		22.6	15.3
Seawater	Temperature	°C	<25	21.9	15.3
	Dissolved oxygen	mg/L	>= 5	9.6	9
	Dissolved Oxygen Saturation	%	>80	103.0	88.5
Control	Temperature	°C	<25	22.2	14.6
	Dissolved oxygen	mg/L	>= 5	9.6	9
	Dissolved Oxygen Saturation	%	>80	103.0	89.8
	Change to temperature	°C	3	0.3	0.7

Comments

Discharges from the North Drain were within permit limits during 2018.

South Drain Discharges

Introduction

Discharges from the South Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the South Drain discharge monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Total Suspended solids	g/m ³		2.2	2.2
• Maximum Quarterly Average	g/m ³	30	3.4	3.5
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			6.5	6.6
Fluoride	g/m ³		5.7	5.8
Conductivity	µS/cm		384	369

Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m ³	2	1.4	1.3
• No. of Times Quarterly Average >2.0 g/m ³	g/m ³	0	0	0
• Maximum Individual Sample		5	1.6	1.6
• No of Times Individual Sample > 5.0 g/m ³	g/m ³		0	0
pH			8.1	8.0
Conductivity			50080	49035
Visible Oil - No. of times Observed			0	0

South Drain Discharges, continued

Control Site water monitoring results

The following table summarises the South Drain weekly control site water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Result	2018 Result
Fluoride	g/m ³		1.3	1.3
• Maximum Quarterly Average	g/m ³		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.4	1.4
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.0
Conductivity	µS/cm		51300	50123
Visible Oil - No. of times Observed			0	0

Annual monitoring results

The following table summarises the South Drain annual water monitoring results during 2018 and shows a comparison with 2017 results.

Site	Parameter	Units	Limit	2017	2018
Discharge	Temperature	°C		23.1	14.9
Seawater	Temperature	°C	<25	22.3	16.5
	Dissolved oxygen	mg/L	>= 5	9.0	8.5
	Dissolved Oxygen Saturation	%	>80	104	85.4
Control	Temperature	°C	<25	22.5	16.6
	Dissolved oxygen	mg/L	>= 5	9	8.5
	Dissolved Oxygen Saturation	%	>80	104	89.8
	Change to temperature	°C	3	0.2	0.1

Comments

Discharges from the South Drain were within permit limits during 2018.

West Drain Discharges

Introduction

Discharges from the West Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the West Drain discharge monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Total Suspended solids	g/m ³		7.9	6.8
• Maximum Quarterly Average	g/m ³	30	11.4	9.0
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			7.2	7.3
Fluoride	g/m ³		2.3	2.0
Conductivity	µS/cm		1455	2797

Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Average	2018 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m ³	2	1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³	g/m ³	0	0	0
• Maximum Individual Sample		5	1.4	1.3
• No of Times Individual Sample > 5.0 g/m ³	g/m ³		0	0
pH			8.1	8.1
Conductivity			51265	50757
Visible Oil - No. of times Observed			0	0

West Drain Discharges, continued

Control Site water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2018 and shows a comparison with 2017 results.

Parameter	Units	Limit	2017 Result	2018 Result
Fluoride	g/m ³		1.3	1.3
• Maximum Quarterly Average	g/m ³		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.4	1.5
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.0
Conductivity	µS/cm		51300	50123
Visible Oil - No. of times Observed			4	0

Annual water monitoring results

The following table summarises the West Drain annual water monitoring results during 2018 and shows a comparison with 2017 results.

Site	Parameter	Units	Limit	2017	2018
Discharge	Temperature	°C		23.9	14.4
Seawater	Temperature	°C	<25	20.7	14.9
	Dissolved oxygen	mg/L	>= 5	8.9	8.8
	Dissolved Oxygen Saturation	%	>80	103.0	87.8
Control	Temperature	°C	<25	20.7	14.6
	Dissolved oxygen	mg/L	>= 5	8.9	9
	Dissolved Oxygen Saturation	%	>80	103	88.7
	Change to temperature	°C	3	0.0	0.3

Comments

Discharges from the West Drain were all within permit limits during 2018.

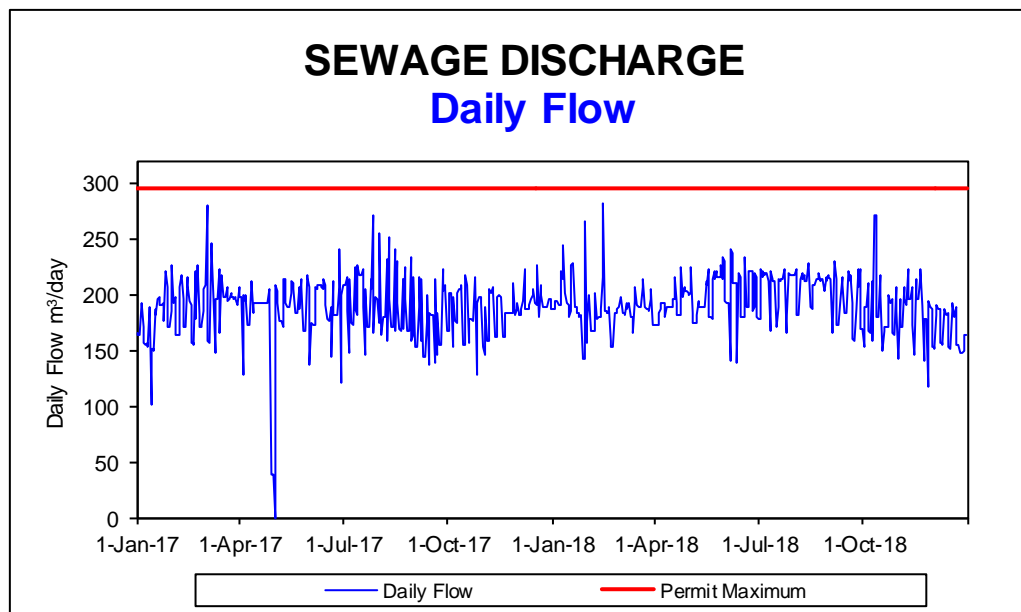
Treated Sewage Discharges

Introduction

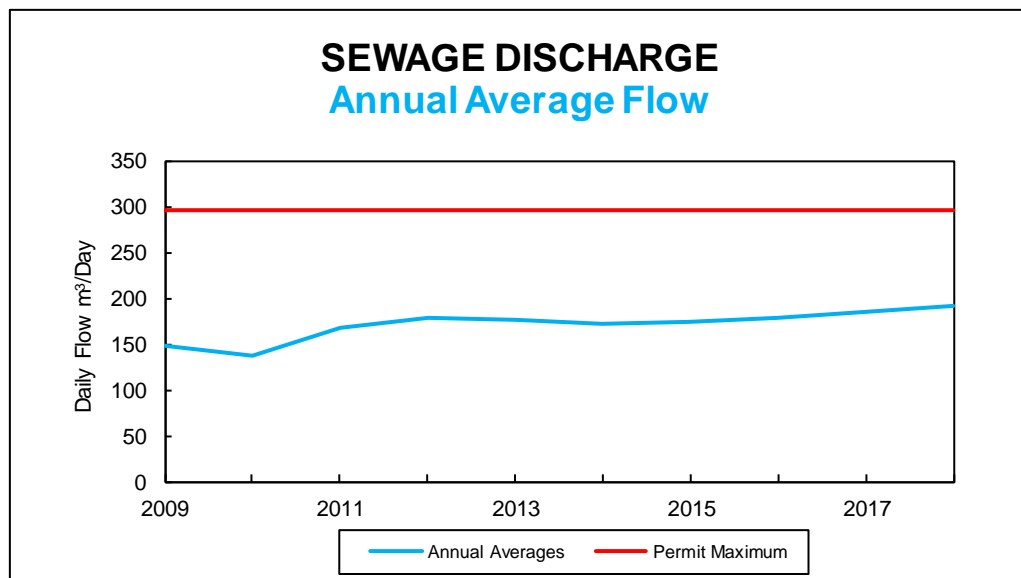
Discharges of treated sewage onto land are covered by Discharge Permit Number 203376, which was granted on 6 June 2006.

Discharge monitoring results

The following graph shows the daily sewage discharge flow during 2017 and 2018. The permit limit for daily flow is 295m³/day.

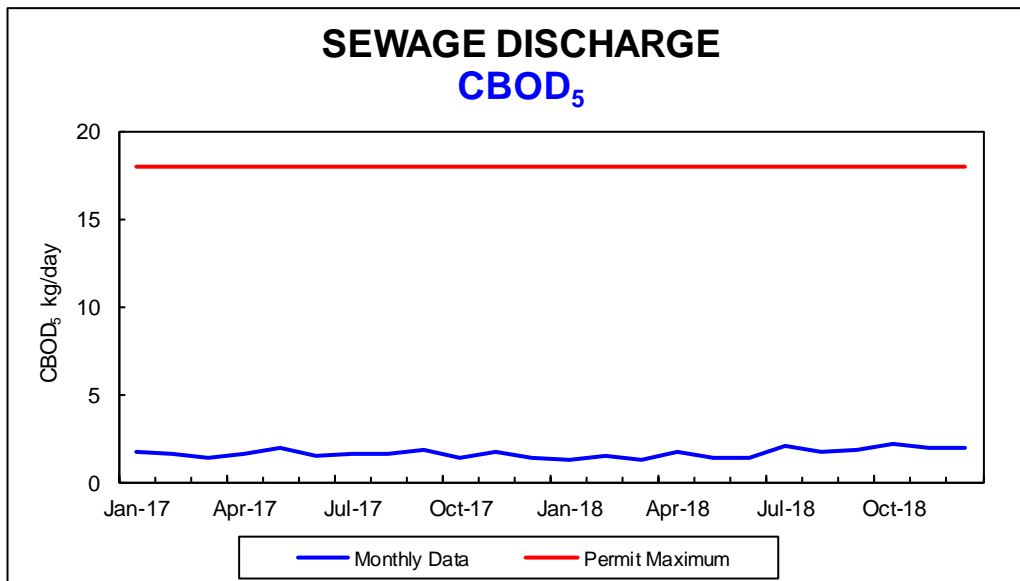


The following graph shows the annual average daily sewage discharge flow into the sewage treatment facility.

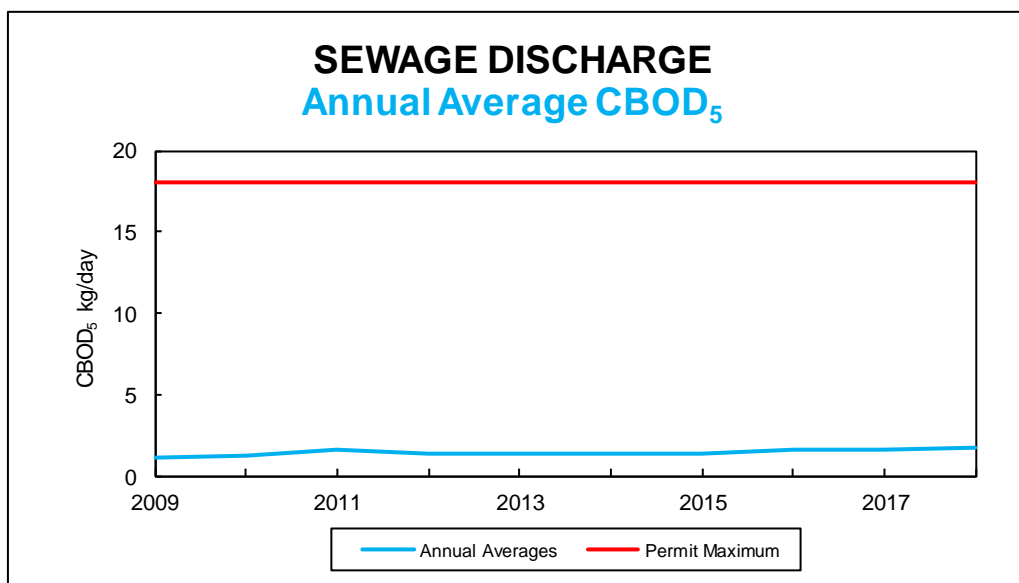


Treated Sewage Discharges, continued

The following graph shows the monthly carbonaceous biochemical oxygen demand (CBOD₅) discharge from the sewage treatment plant during 2017 and 2018. The permit limit for CBOD₅ is 18kg/day.

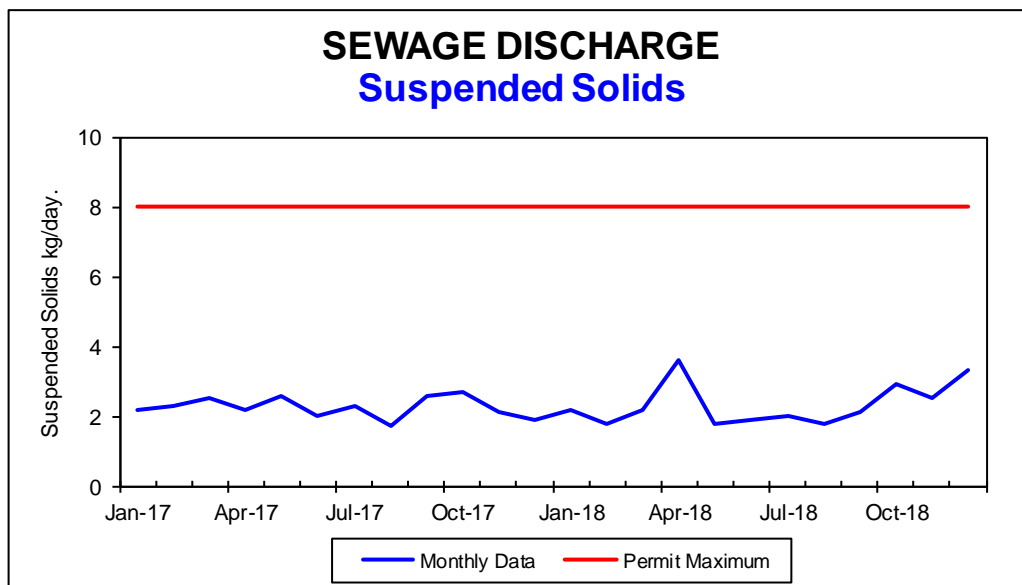


The following graph shows the annual average CBOD₅ discharge from the sewage treatment plant.

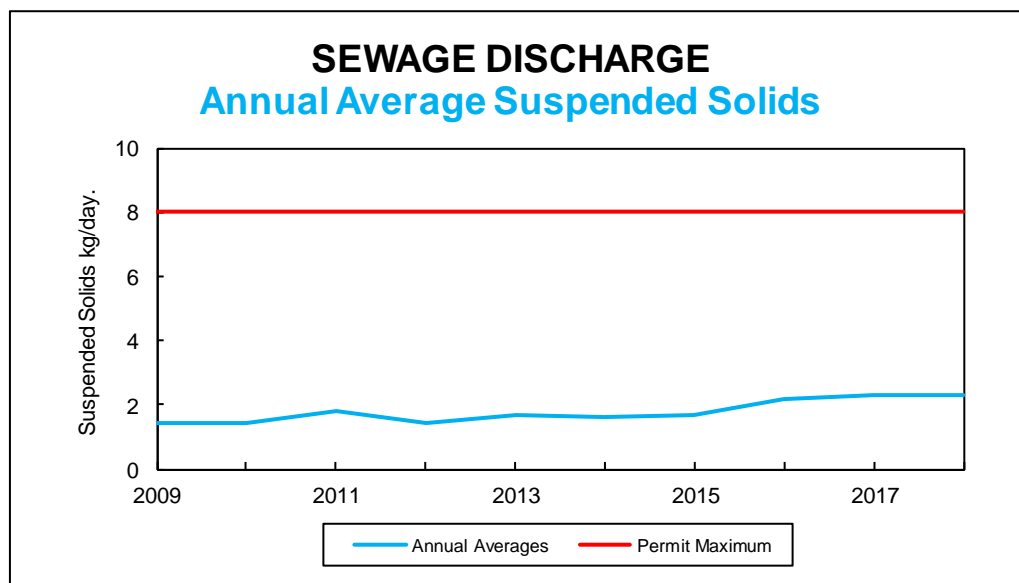


Treated Sewage Discharges, continued

The following graph shows the monthly suspended solids in the discharge from the sewage treatment plant during 2017 and 2018. The permit limit for suspended solids is 8 kg/day.



The following graph shows the annual average suspended solids discharge from the sewage treatment plant.



Treated Sewage Discharges, continued

Land disposal area groundwater monitoring results

The following table summarises the results of groundwater monitoring near to the area where sewage is discharged to land.

Parameter	Units	2017 Average	2018 Average	Previous Range (post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2
Total phosphorus	g/m ³	0.70	0.73	0.046 - 1.07
Total ammoniacal-N	g/m ³	<0.01	< 0.01	< 0.01 - 0.03
Nitrate-N	g/m ³	<0.01	0.04	< 0.01 - 0.058
Total Nitrogen	g/m ³	0.29	0.29	0.02 - 0.4
pH		8.0	7.8	7.4 - 8.1
Conductivity	µS/cm	353	370	305 - 399
Chlorinated Aliphatic HC	g/m ³	ND	B.L.	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2 - 65
Total phosphorus	g/m ³	0.15	0.25	< 0.01 - 0.42
Total ammoniacal-N	g/m ³	<0.01	<0.01	< 0.01 - 0.02
Nitrate-N	g/m ³	0.44	0.31	< 0.01 - 0.61
Total Nitrogen	g/m ³	0.87	0.93	0.05 - 1.17
pH		7.9	7.8	6.8 - 7.9
Conductivity	µS/cm	402	419	227 - 503
Chlorinated Aliphatic HC	g/m ³	ND	B.L.	B.L.

Chlorinated Aliphatic Hydrocarbons only determined biennially.

ND - not done

BL - below detection limit

Comments

The discharges of treated sewage onto land during 2018 were similar to previously seen. Phosphorus and nitrogen levels are still elevated due to another fire on the Peninsula in January 2018. The fire was burning right around the sewage field.

Treated Effluent Discharges

Introduction

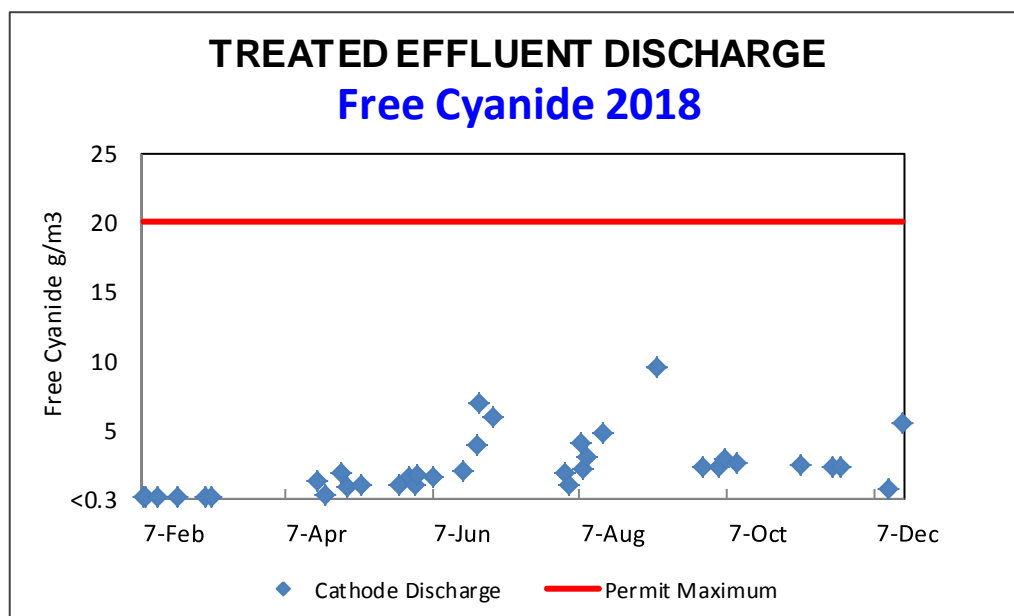
Discharges of treated effluent into Foveaux Strait are covered by Coastal Permit Number 203375 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the results of treated effluent discharge monitoring during 2018 and shows a comparison with the 2017 results.

Parameter	Units	Limits	2017 Result	2018 Result
Maximum daily discharge	m ³ /day	140	80	80
Suspended Solids				
Maximum Concentration		100	74	53
Average Concentration	g/m ³		22.4	12.5
No.> 100 g/m ³		0	0	0
Free Cyanide				
Maximum Concentration	g/m ³	20	3.97	9.5
Average Concentration			1.5	2.2
No.> 20 g/m ³		0	0	0

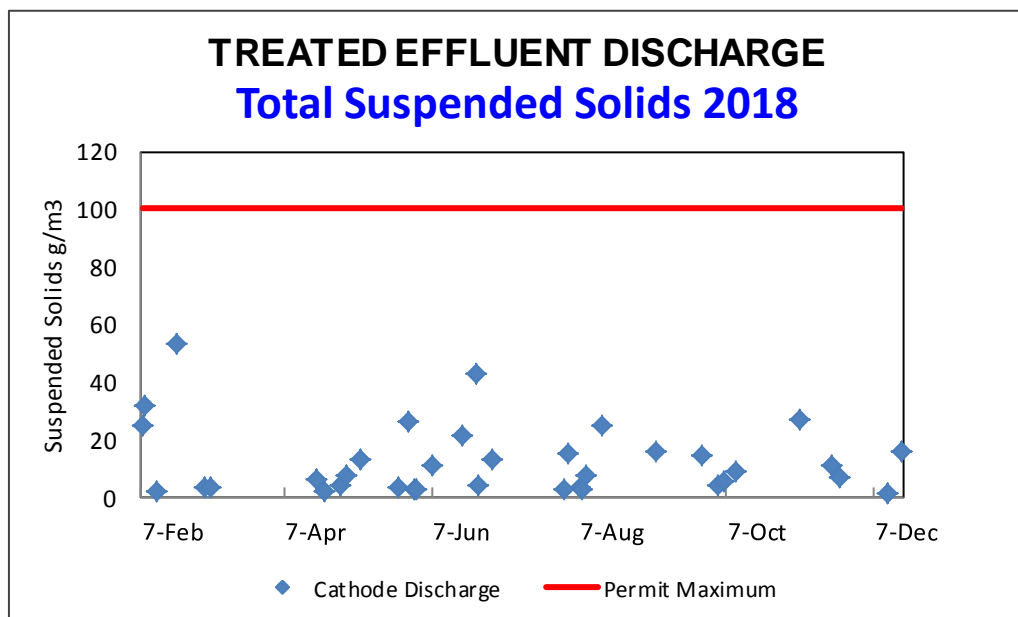
The following graph shows the free cyanide concentration of treated effluent discharged during 2018



Treated Effluent Discharges, continued

Discharge monitoring results, continued

The following graph shows the total suspended solids concentration of treated effluent discharged during 2018.



Discharge rate

The following table shows the average, maximum and minimum discharge rates for the discharge of treated effluent to Foveaux Strait during 2016, 2017 and 2018.

There were 36 discharges throughout 2018 with a total volume of 2880m³ discharged.

Parameter	Units	2015 Result	2016 Result	2017 Result
Average Discharge Rate	L/min	5	5	5
Maximum Discharge Rate	L/min	5	5	5
Minimum Discharge Rate	L/min	5	5	5

Comments

During 2018 all cathode discharges were within permit limits

Treated Effluent Discharges, continued

Annual Coastal Water Monitoring Results

The following table summarises the annual coastal water monitoring for the discharge of treated effluent.

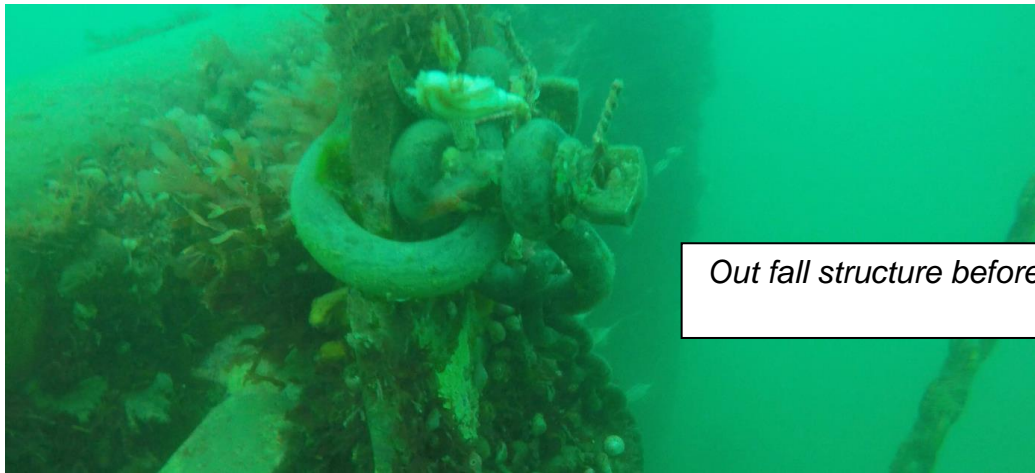
Site	Parameter	Units	Limit	2017	2018
Coastal	Fluoride	g.m ⁻³		1.3	1.2
	Total Cyanide	g.m ⁻³		0.026	<0.01
	Conductivity	µS/cm		49686	49329
	pH			8.1	8.1
	Dissolved Oxygen	mg/L	≥5	9.7	8.8
	% Saturation	%	>80	95.7	92.4
	Temperature	°C	<25	13.9	16.9
Control	Fluoride	g.m ⁻³		1.3	1.3
	Total Cyanide	g.m ⁻³		0.02	<0.01
	Conductivity	µS/cm		49286	49450
	pH			8.1	8.2
	Dissolved Oxygen	mg/L	≥5	9.8	8.9
	% Saturation	%	>80	94.8	91.7
	Temperature	°C	<25	13.9	16.9
	Change to Temperature	°C	3	0.0	0

Condition of the Cathode Discharge Structure

The Cathode Outfall Discharge Structure including the diffuser was inspected on the 5th of March 2018. Overall the structure was found to be in good condition in an upright position on the seafloor as intended with all above parts having between 65-75% of their life remaining until replacement will be needed.

The chain was subsequently replaced on the 25th of July 2018. The zincs, shackles as well as buoy attachment points were found to be in a serviceable condition and were reinstated on the new chain.

Growth on the structure was found to be similar to other years. The structure was scraped clean, making sure to leave any small snails and shell fish in place as they eat a large portion of the weed that would normally grow during the course of the year. All discharge tubes were cleaned of growth and blockages removed.



Out fall structure before cleaning



Main diffuser pipe after cleaning



New chain in place

Comments

The annual coastal water monitoring parameters were all within permit limits for 2018.

Part K - Landfill Operations

Introduction

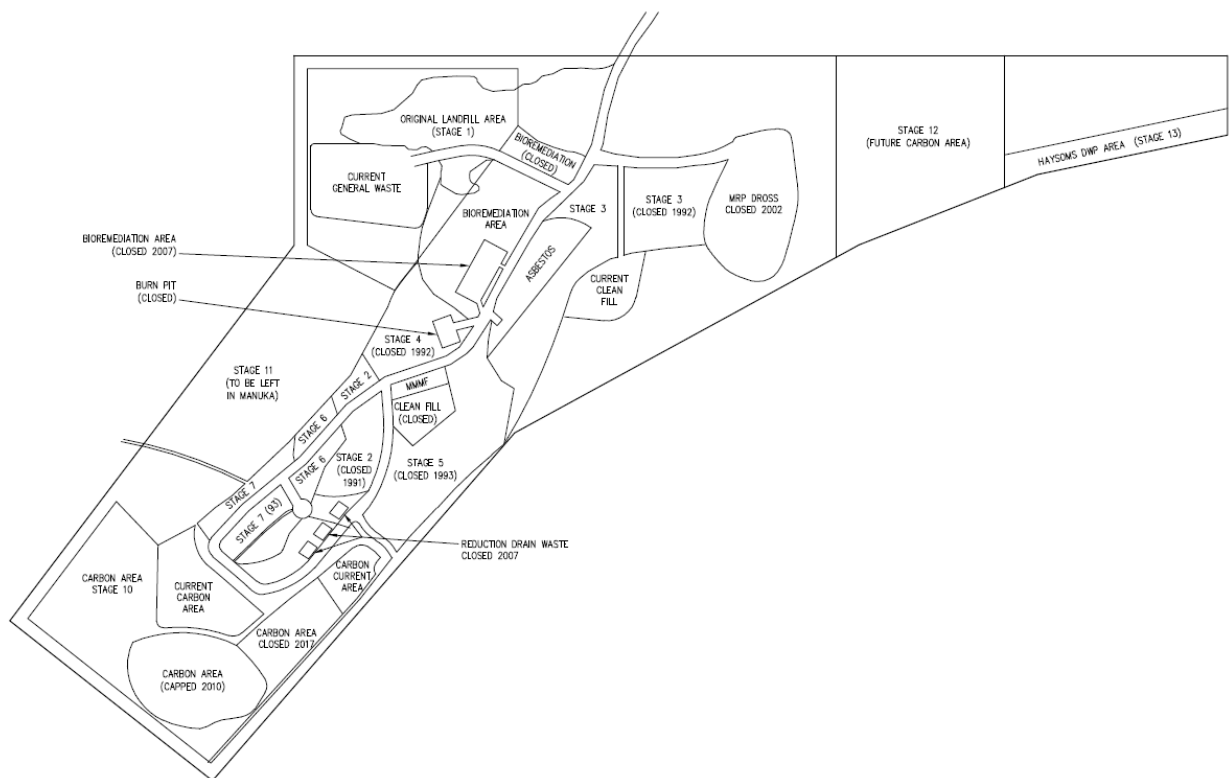
Operation of the landfill on the smelter's Tiwai Point property is covered by Discharge Permit No. 202196 issued by the Southland Regional Council on 8 December 2004.

The general operation of the on-site landfill is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2019 are included in the following sections:

- proposed operation at the landfill for the next twelve months,
- comments on operations for 2018, and
- 2018 groundwater monitoring results.

Proposed Operation For 2019

The operation of the General waste and Clean fill areas will continue with no major changes proposed for 2019. Those areas have capacity for many years of future landfilling and do not require any structural changes within the next 12 months.



Carbon Waste

The CARBON AREA STAGE 10 on the map above will be opened for carbon material in 2019.

MMMF

A new cell for MMMF is planned for 2019 for future deposits in the same area to the west of the current cell.

MRP Dross

It is not anticipated that any dross from the MRP cell will be processed during 2019.

Comments on Operations for 2018

In August NZAS received a complaint from a member of the public of excessive fugitive dust coming from the Landfill during exceptionally high winds conditions. NZAS staff immediately responded by wetting down that area of the Landfill to reduce the dusting.

General Waste Stockpile

A small fire occurred in the general waste cell on 4th of September 2018. The course of the fire is not known. It was a very hot and sunny day and perhaps some easy combustible material started the fire in the pile. The fire was quickly brought under control by the NZAS fire brigade and extinguished within an hour.



The face was worked from the west to the east along the access road. The long term intentions are to increase the height of the area rather than enlarge the foot print. The general waste area was progressively capped with pea gravel as per the Landfill Management Plan.

Man Made Mineral Fibre Stockpile

The pit that was dug south of the old pit in 2015 was used during 2018. Pit was nearly full at the end of 2018. A significant amount of material from a furnace pit rebuilt in March 2019 is expected so that will likely require a new cell to be dug.

Metal Reclamation Plant Stockpile

Dross was not mined from the old MRP area during 2018. The independent company Inalco process the current arising of dross and some of the material containerised stored on site during 2018. No dross from the MRP pile was processed in 2018. The long term plan is for Inalco to process the rest of the containerised dross and the landfilled MRP stock pile.

Carbon Stockpiles

A small extension of the carbon face was created to the north/west to extend the life of this disposal area. The south side of the carbon pile was closed and covered in wood chips for vegetation to self-generate over time.

Timber Stockpile

Waste timber was stock piled in the landfill by the non-classifiable pile for future chipping. No waste timber was chipped in 2018. Plans are in place to chip timber in mid-2019.

Amount and Type of Materials Deposited

Introduction

As per NZAS' consent conditions for landfill operations, a report detailing waste sent to landfill is required to be submitted every second year. The last full report was for the calendar year 2015.

Since December 2013 TrueSouth Surveyors have performed an aerial drone survey of the NZAS landfill using UAV and photogrammetry. This method provides orthometric photos from which volume increases of the various stockpiles can be calculated. The first year data using this method was reported was 2014. The following areas are surveyed annually:

- general waste,
- clean fill,
- carbon,
- MRP dross, and
- Haysom's dross (control site)



The December 2018 survey provided the following estimates for volumes of material deposited during 2018:

Waste deposited at NZAS Landfill in 2018		
Waste Material	Increase (m3)	Comments
General pile	373	Significant decrease on 2017 volume. Less gravel used to bury the waste has decrease the overall volume increase.
Clean pile	563	Back to usual from a high volume experienced in 2017for bricks and concrete
Carbon pile	4771	Increased significantly compared to last year. NZAS is recycling less waste carbon back into the process due to now manufacturing high purity anodes using virgin carbon.
MRP dross	-58	No material has been processed from this pile during 2018. Material has been moved around on the pile changing the profile; however it is within the accuracy of the measuring method.

To ensure that the photogrammetry method is reliable the Haysom's dross pile was measured as a control site. This pile had no material added or removed between 2013 and 2018. The following results were obtained:

Control Sites		
Waste Material	Increase (m3)	Comments
2003 Haysom dross	380	Equates to a height increase of 4cm which is likely to be a natural increase in the vegetation height on the pile.

The table above shows that the aerial survey method is highly accurate if no vegetation is present. There is no vegetation on the current general, clean, carbon or MRP piles.

Comments on Carbon Pile

The individual waste streams deposited in the carbon area is weighed and summarized in table below. The increase is mainly due to less carbon waste recycled back into the process so more high purity metal can be produced. This trend may continue as NZAS is continuously striving to optimise the production of pure aluminium.

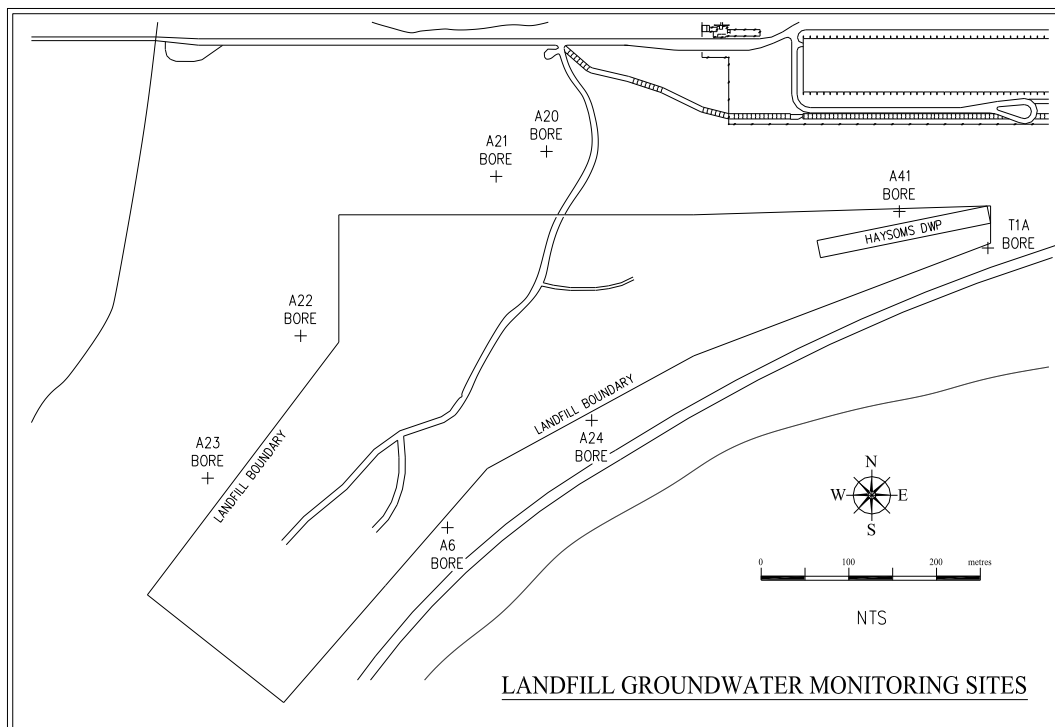
Measured Process Waste to the NZAS Carbon Pile By Material 2015 - 2018				
Material	2015	2016	2017	2018
Alumina	30	24	30	28
Carbon	2744	2772	2879	3960
Furnace Slag (mainly carbon)	386	411	419	471
Reject Bath	59	9	24	66
Resistor Coke (mainly carbon)*	648	303	142	3
Miscellaneous (Mixture)	54	148	80	72
Total Process (tonnes)	3921	3667	3574	4600

*A complete change in June 2017 from carbon to graphite on start-up of cells resulted in next to no solid material (resistor coke) to be removed from the cell when it is operating. The graphite is consumed in the cell.

Landfill Groundwater Monitoring

Site locations

The locations of the groundwater monitoring bores are as shown in the following map. Three of the bores are north (upstream) of the landfill, and there are three bores south east and two bores west (downstream) of the landfill.



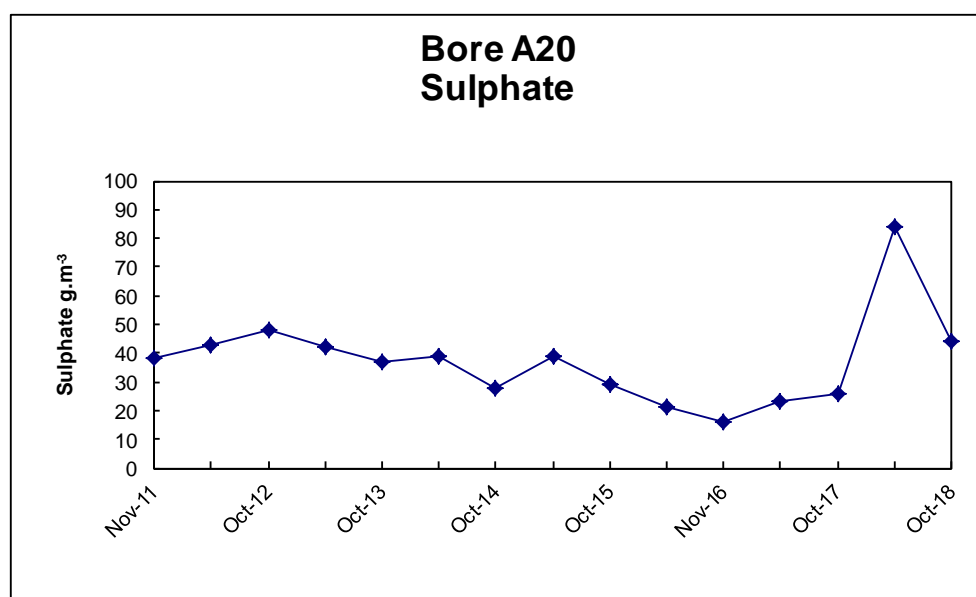
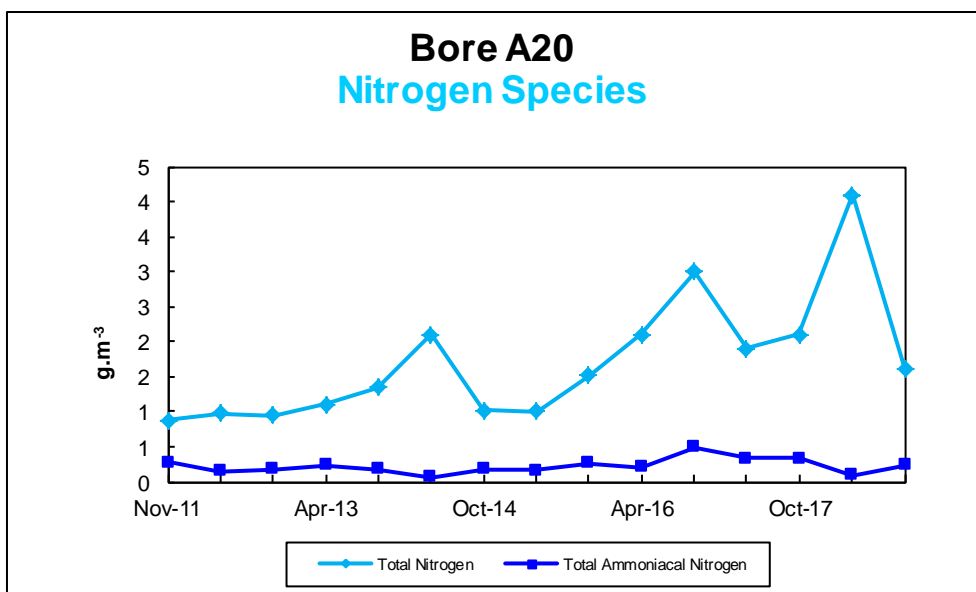
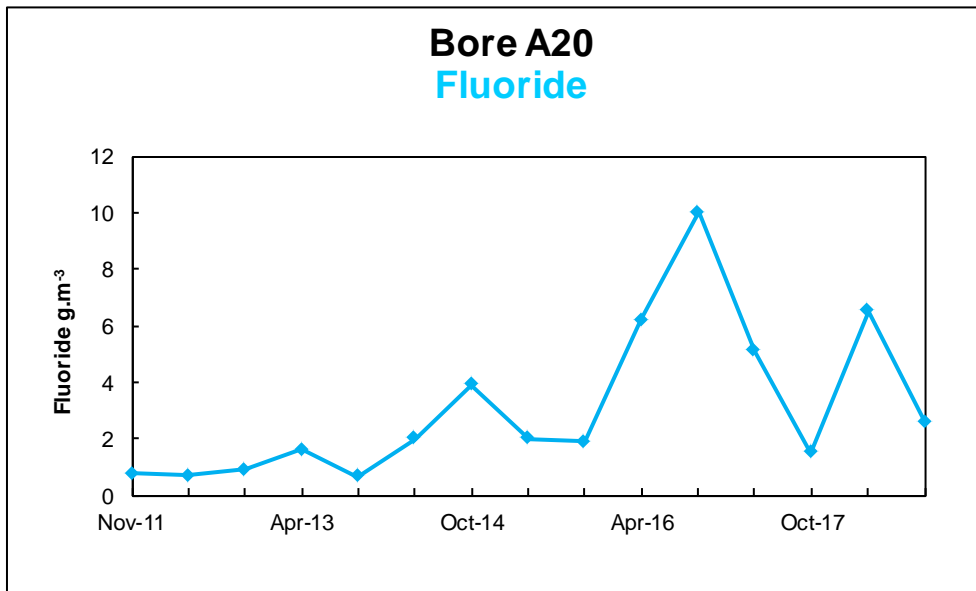
Landfill Groundwater Monitoring, Continued

Bore A20 monitoring results

The table below shows a summary of results from samples collected from bore A20 during 2017 and 2018. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	°C	13.2	N.D.	7.5 - 13.4
pH		6.1	6.1	5.1 - 7.2
Conductivity	µS/cm	796	818	566 - 1063
Alkalinity	g/m ³	53	29	8 - 240
Carbonaceous BOD5	g/m ³	<2	<2	<1 - 6
Total Nitrogen	g/m ³	2.0	2.9	0.1 - 4.1
Total Ammoniacal Nitrogen	g/m ³	0.34	0.16	0.02 - 0.49
Fluoride	g/m ³	3.30	4.60	0.03 - 11
Sulphate	g/m ³	25	64	16 - 84
Total Iron	g/m ³	13.8	4.7	0.46 - 26
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 11.6
Total Kjeldahl Nitrogen	g/m ³	1.95	2.8	0.2 - 4
Nitrate Nitrogen	g/m ³	0.050	N.D.	<0.002 - 14
Nitrite Nitrogen	g/m ³	0.050	N.D.	<0.002 - 0.1
Weak Acid Dissociable Cyanide	g/m ³	<0.002	N.D.	<0.001 - 0.1
Boron	g/m ³	0.044	N.D.	0.032 - 0.067
Manganese	g/m ³	0.24	N.D.	0.111 - 0.394
Nickel	g/m ³	0.0065	N.D.	0.0018 - 0.01
Potassium	g/m ³	3.6	N.D.	2.9 - 4.1
Vanadium	g/m ³	0.0107	N.D.	<0.001 - 0.0107

N.D: Not analysed – only required biennially.



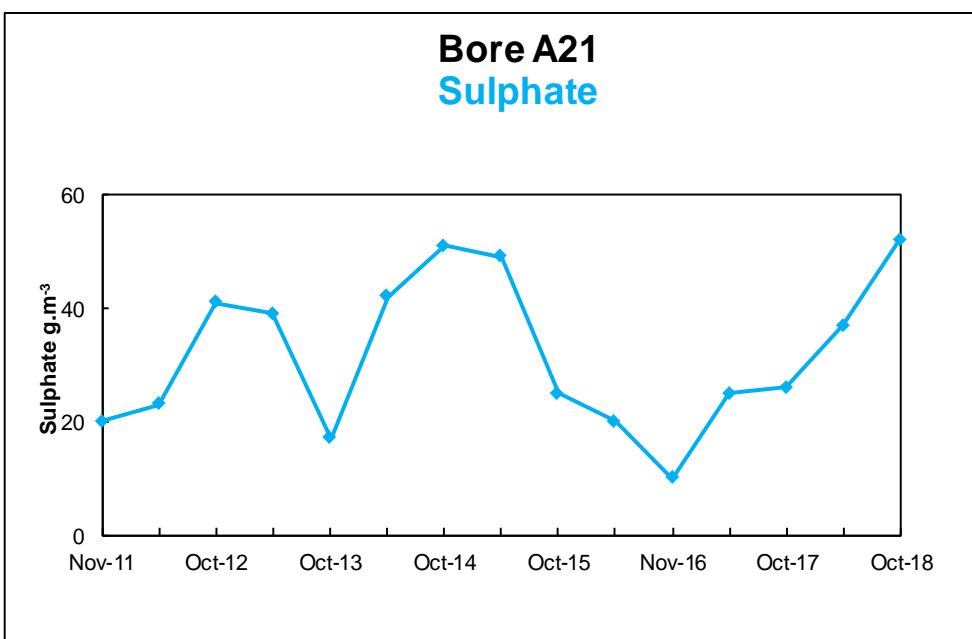
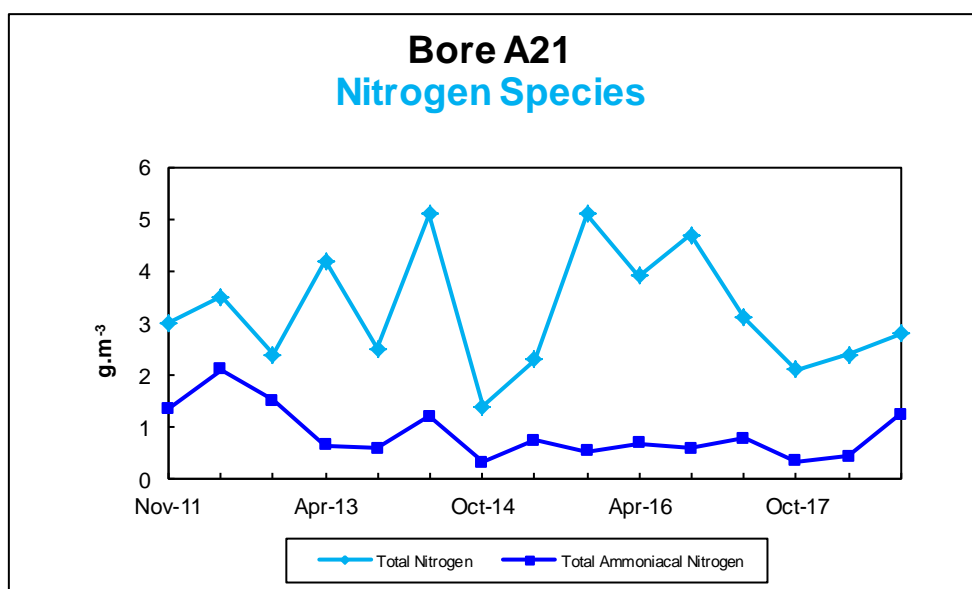
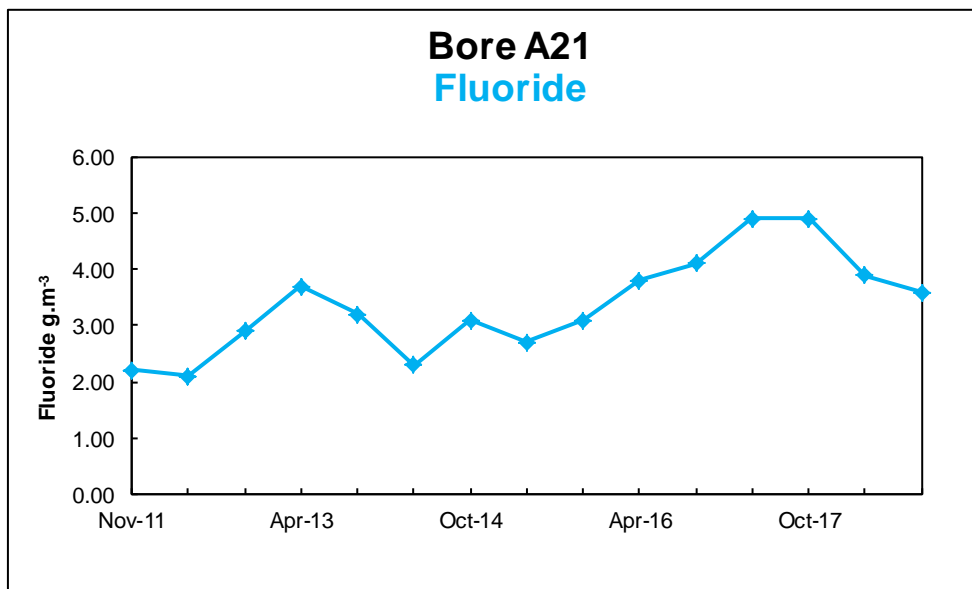
Landfill Groundwater Monitoring, Continued

Bore A21 monitoring results

The table below shows a summary of results from samples collected from bore A21 during 2017 and 2018. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	⁰ C	10.3	N.D.	6.5 - 13.7
pH		6.1	5.7	5.1 - 6.9
Conductivity	µS/cm	436	1026	427 - 1723
Alkalinity	g/m ³	66	13	1 - 160
Carbonaceous BOD5	g/m ³	<2	<2	<0.1 - 16
Total Nitrogen	g/m ³	2.6	2.6	0.7 - 8
Total Ammoniacal Nitrogen	g/m ³	0.6	0.8	0.1 - 4.6
Fluoride	g/m ³	4.9	3.8	0.2 - 4.9
Sulphate	g/m ³	26	45	8 - 114
Total Iron	g/m ³	10.1	8.9	0.66 - 94.6
Naphthalene	mg/m ³	0.1	<0.1	<0.1 - 1
Anthracene	mg/m ³	<0.1	<0.1	<0.02 - 0.2
Phenanthrene	mg/m ³	<0.1	<0.1	<0.005 - 0.2
Fluoranthene	mg/m ³	<0.1	<0.1	<0.02 - 0.2
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 7.3
Total Kjeldahl Nitrogen	g/m ³	3.4	2.6	0.8 - 6.5
Nitrate Nitrogen	g/m ³	0.05	N.D.	0 - 29
Nitrite Nitrogen	g/m ³	0.05	N.D.	<0.002 - 0.05
Weak Acid Dissociable Cyanide	g/m ³	0.0005	N.D.	<0.001 - 0.1
Boron	g/m ³	0.047	N.D.	0.047 - 0.154
Manganese	g/m ³	0.094	N.D.	0.064 - 0.473
Nickel	g/m ³	0.0052	N.D.	<0.0005 - 0.007
Potassium	g/m ³	4.2	N.D.	4.2 - 11
Vanadium	g/m ³	0.038	N.D.	0.001 - 0.043

N.D: Not analysed – only required biennially.



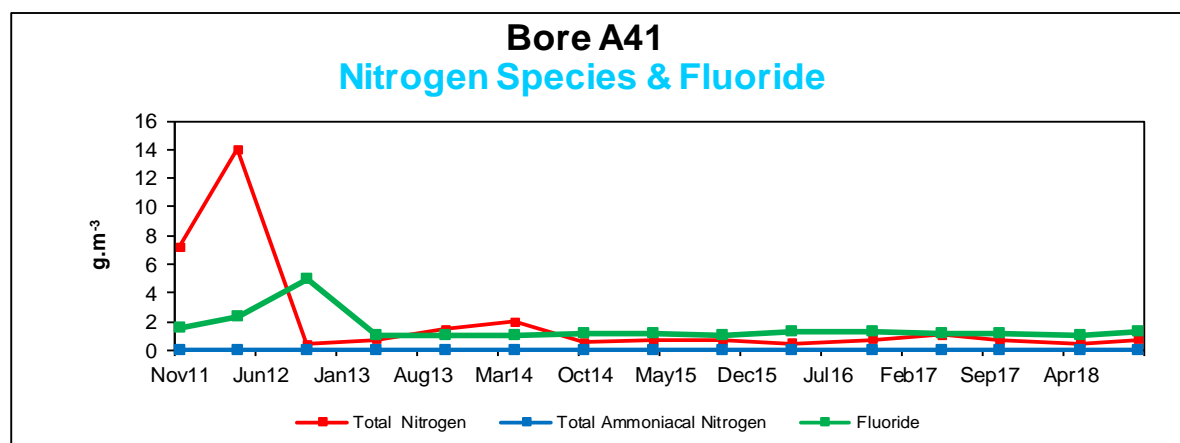
Landfill Groundwater Monitoring, Continued

Bore A41 monitoring results

The table below shows a summary of results from samples collected from bore A41 during 2017 and 2018. Bore A41 is located north of the Haysoms' area (upstream).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
pH	-	6.4	6.0	5.8 - 7.9
Alkalinity	g/m ³	33	16	8.6 - 170
Temperature	°C	12	N.D.	5.8 - 7.9
Conductivity	µS/cm	422	449	282 - 984
Carbonaceous BOD ₅	g/m ³	1	1	0.5 - 1
Fluoride	g/m ³	1.2	1.2	0.25 - 5
Sulphate	g/m ³	24	27	19.2 - 47
Total Iron	g/m ³	0.10	0.07	0.04 - 0.63
Boron	g/m ³	0.04	N.D.	0.036 - 4.1
Manganese	g/m ³	<0.01	N.D.	<0.01 - 0.023
Potassium	g/m ³	1.52	N.D.	0.27 - 4.8
Vanadium	g/m ³	1.52	N.D.	<0.002 - 0.011
Nickel	g/m ³	0.0009	N.D.	0.0005 - 0.004
Ammoniacal-Nitrogen	g/m ³	0.01	0.03	0.005 - 0.16
Total Nitrogen	g/m ³	0.86	0.60	0.39 - 26
Total Kjeldahl Nitrogen	g/m ³	0.66	0.50	0.28 - 3.1
Nitrate Nitrogen	g/m ³	0.10	N.D.	0.1 - 23
Nitrite Nitrogen	g/m ³	0.05	N.D.	<0.002 - 0.2
Total Petroleum Hydrocarbons	g/m ³	N.D.	N.D.	<1
Weak Acid Dissociable Cyanide	g/m ³	0	N.D.	0.0005 - 0.0035

N.D: Not analysed – only required biennially.



Landfill Groundwater Monitoring, Continued

Bore A22 monitoring results

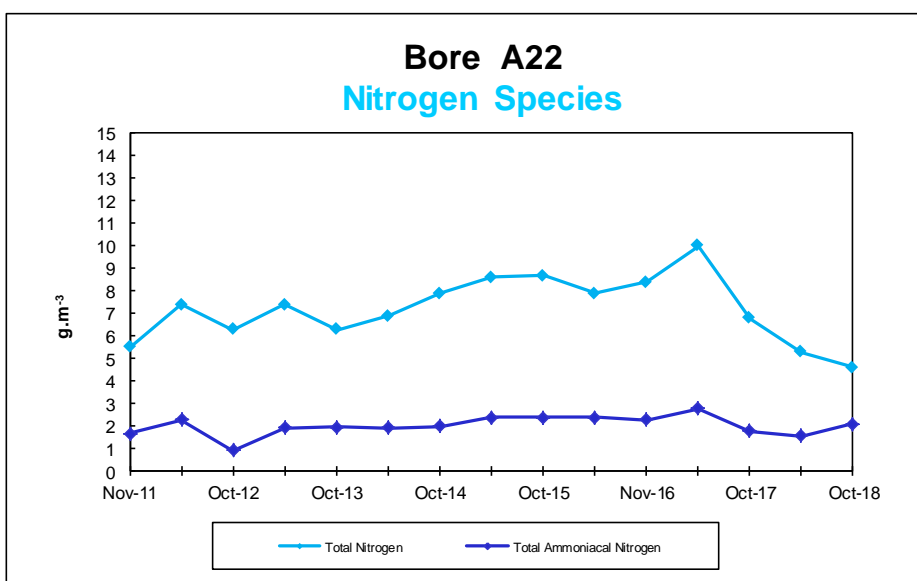
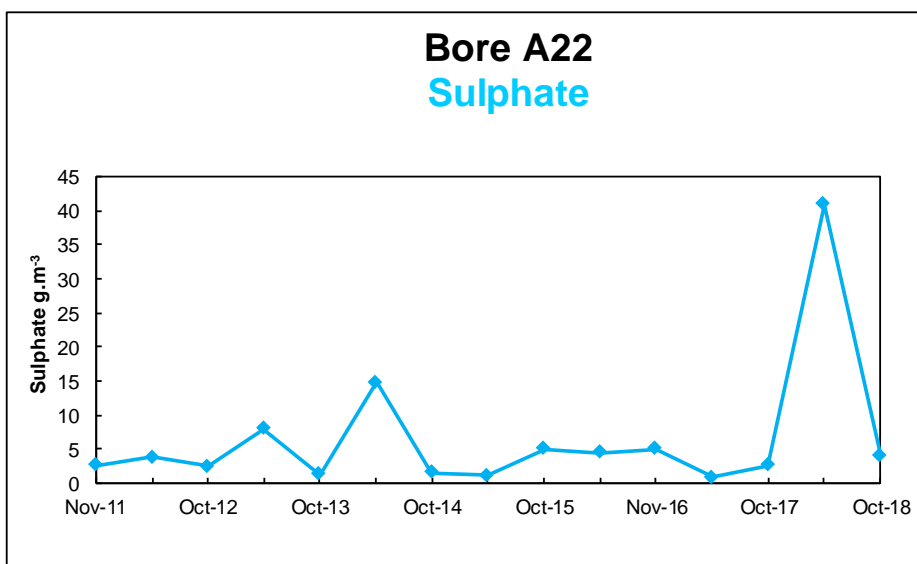
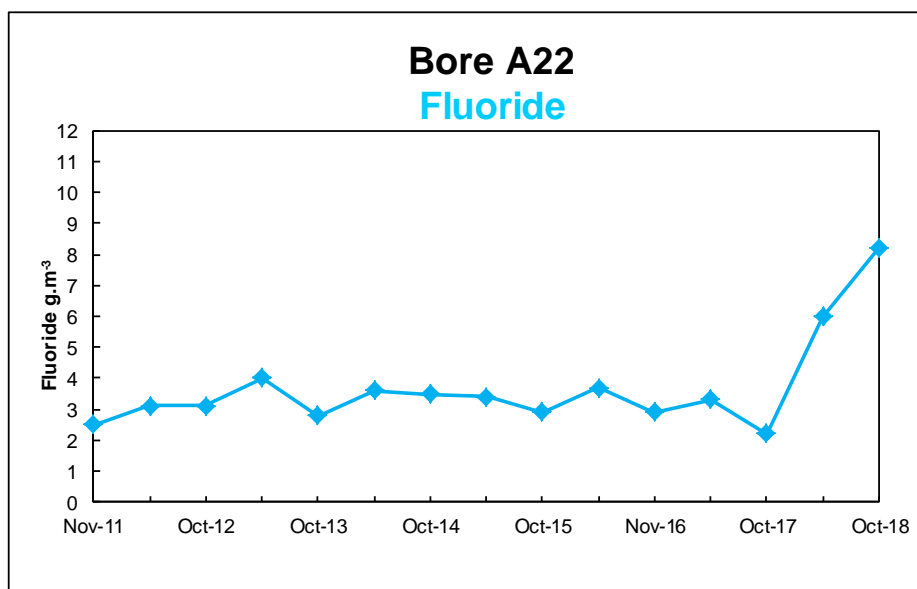
The table below shows a summary of results from samples collected from bore A22 during 2017 and 2018. Bore A22 is located west of the landfill. (SW of general pile).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	°C	10.2	N.D.	8.6 - 12.1
pH		5.1	5.9	4.2 - 7.3
Conductivity	µS/cm	574	505	354 - 1204
Alkalinity	g/m ³	14	46	1 - 294
Carbonaceous BOD5	g/m ³	5	2	<1 - 15
Total Nitrogen	g/m ³	8.4	5	0.42 - 10
Total Ammoniacal Nitrogen	g/m ³	2.30	1.84	0.01 - 2.8
Fluoride	g/m ³	2.8	7.1	0.03 - 7.1
Sulphate	g/m ³	2	22	0 - 165
Total Iron	g/m ³	3.55	9.3	0.59 - 9.3
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 7.1
Total Kjeldahl Nitrogen	g/m ³	8.3	5	0.9 - 9.9
Nitrate Nitrogen	g/m ³	0.05	N.D.	<0.02 - 0.2
Nitrite Nitrogen	g/m ³	0.05	N.D.	<0.002 - 0.13
Weak Acid Dissociable Cyanide	g/m ³	<0.001	N.D.	<0.001 - 0.1
Boron	g/m ³	0.042	N.D.	0.006 - 0.071
Manganese	g/m ³	0.039	N.D.	0.0049 - 0.394
Nickel	g/m ³	0.0056	N.D.	0.0007 - 0.01
Potassium	g/m ³	3.8	N.D.	1.65 - 5.3
Vanadium	g/m ³	0.0101	N.D.	0.002 - 0.022

N.D: Not analysed – only required biennially.

Comment

Highest level of fluoride and iron ever recorded for bore A22. There was a fire in the landfill in September 2018 near this bore which may have influenced the sampling performed in October 2018.



Landfill Groundwater Monitoring, Continued

Bore A23 monitoring results

The table below shows a summary of results from samples collected from bore A23 during 2017 and 2018. Bore A23 is located west of the landfill. (NW of carbon pile).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	⁰ C	10.7	N.D.	9 - 12.5
pH		6.0	5.8	5.4 - 6.4
Conductivity	µS/cm	493	489	378 - 745
Alkalinity	g/m ³	30	32	31 - 60
Carbonaceous BOD5	g/m ³	1	1	<1 - 5
Total Nitrogen	g/m ³	3.40	2.25	0.88 - 3.4
Total Ammoniacal Nitrogen	g/m ³	0.9	1.12	0.05 - 1.4
Fluoride	g/m ³	0.3	0.3	<0.1 - 0.36
Sulphate	g/m ³	1.55	0.25	0.25 - 30
Total Iron	g/m ³	3.6	4.7	2.6 - 13
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 7.2
Total Kjeldahl Nitrogen	g/m ³	3.4	2.2	1.1 - 3.4
Nitrate Nitrogen	g/m ³	0.05	N.D.	<0.02 - 0.05
Nitrite Nitrogen	g/m ³	0.05	N.D.	<0.02 - 0.019
Weak Acid Dissociable Cyanide	g/m ³	<0.001	N.D.	<0.001 - 0.1
Boron	g/m ³	0.043	N.D.	0.04 - 0.05
Manganese	g/m ³	0.04	N.D.	0.05 - 0.12
Nickel	g/m ³	0.0023	N.D.	<0.0005 - 0.0016
Potassium	g/m ³	4	N.D.	4 - 5
Vanadium	g/m ³	0.0139	N.D.	0.013 - 0.021

N.D: Not analysed – only required biennially

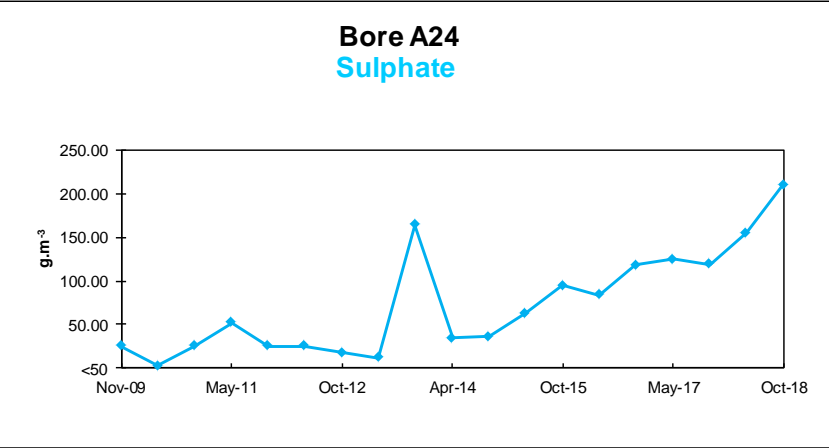
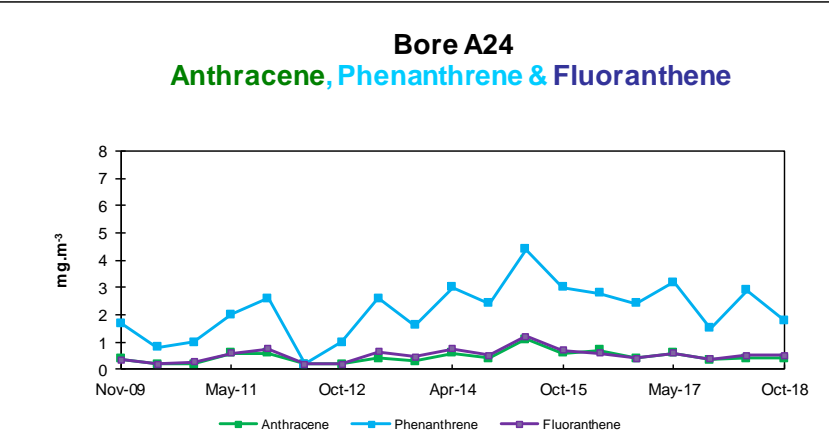
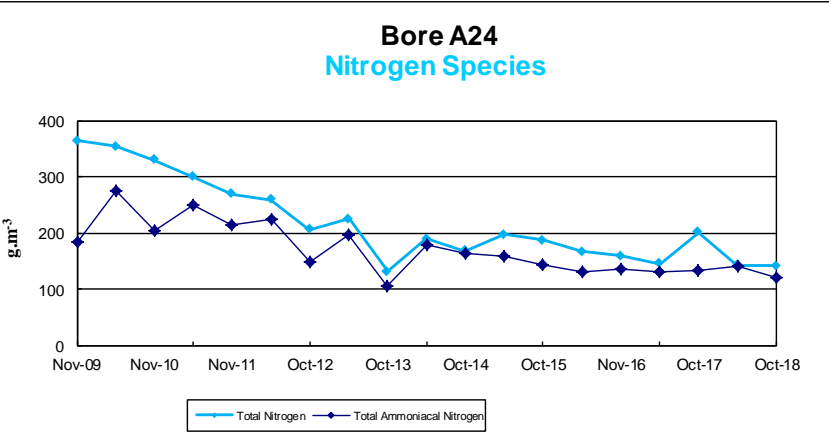
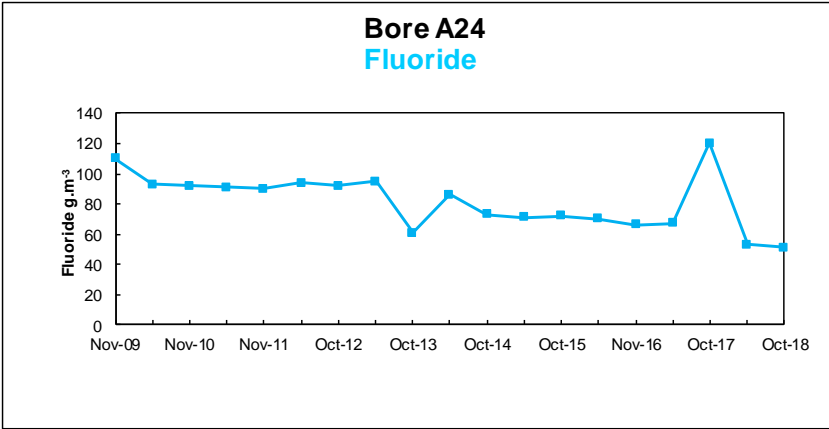
Landfill Groundwater Monitoring, Continued

Bore A24 monitoring results

The table below shows a summary of results from samples collected from bore A24 during 2017 and 2018. Bore A24 is located east of the landfill. (SE of clean fill, SW of MRP).

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	°C	13.6	N.D.	9.4 - 13.6
pH		8.4	8.2	6.9 - 8.7
Conductivity	µS/cm	3260	3165	447 - 7290
Alkalinity	g/m ³	1153	1018	108 - 2600
Carbonaceous BOD5	g/m ³	177	10	2 - 340
Total Nitrogen	g/m ³	174	143	16.8 - 560
Total Ammoniacal Nitrogen	g/m ³	133	132	28.2 - 450
Fluoride	g/m ³	94	52	<0.1 - 120
Sulphate	g/m ³	122	183	0 - 312
Total Iron	g/m ³	33	20	8.2 - 60
Naphthalene	mg/m ³	229	27.25	0.06 - 510
Anthracene	mg/m ³	0.48	0.4	<0.3 - 1.2
Phenanthrene	mg/m ³	2.355	2.4	<0.3 - 4.9
Fluoranthene	mg/m ³	0.49	0.5	<0.3 - 1.2
Total Petroleum Hydrocarbons	g/m ³	2	N.D.	<1 - 18.6
Total Kjeldahl Nitrogen	g/m ³	173	140	63 - 560
Nitrate Nitrogen	g/m ³	0.05	N.D.	0.05 - 33
Nitrite Nitrogen	g/m ³	0.27	N.D.	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m ³	0.015	N.D.	<0.01 - 0.1
Boron	g/m ³	6.8	N.D.	4.1 - 17
Manganese	g/m ³	0.08	N.D.	0.08 - 0.22
Nickel	g/m ³	0.01	N.D.	0.004 - 0.05
Potassium	g/m ³	39	N.D.	11 - 79
Vanadium	g/m ³	0.59	N.D.	0.21 - 2.54

N.D: Not analysed – only required biennially



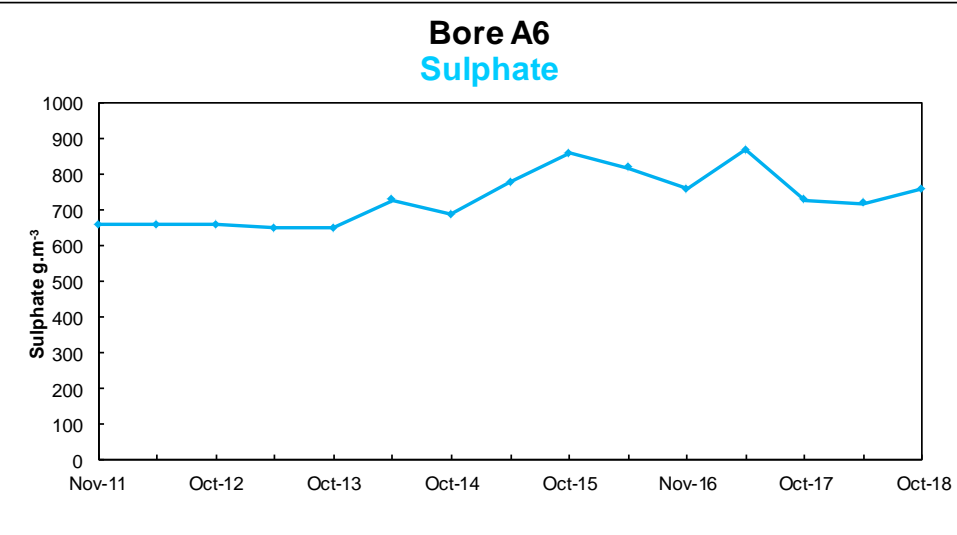
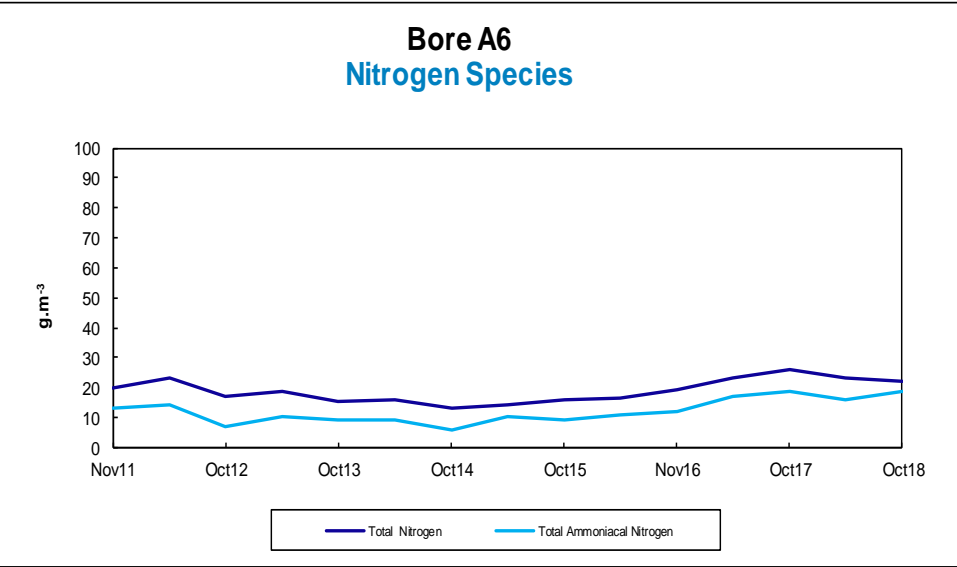
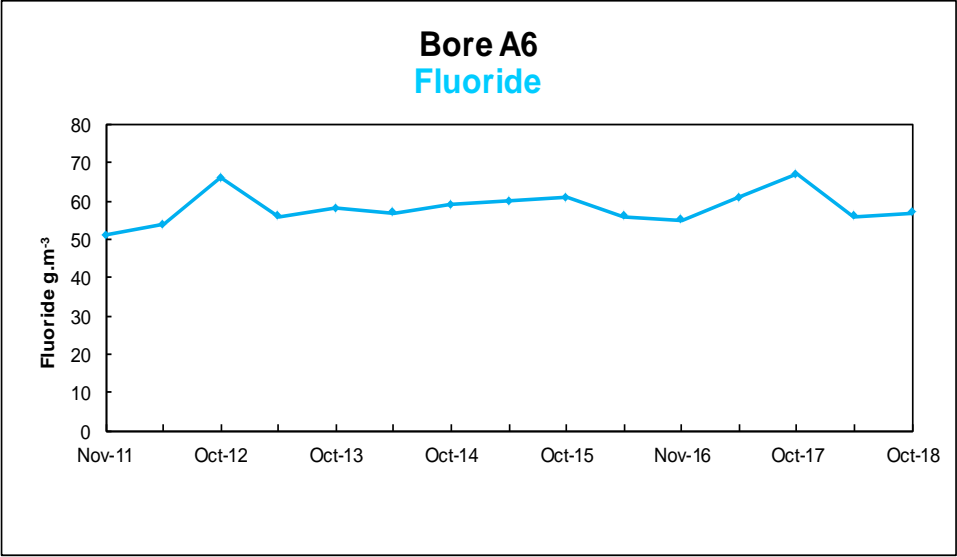
Landfill Groundwater Monitoring, Continued

Bore A6 monitoring results

The table below shows a summary of results from samples collected from bore A6 during 2017 and 2018. Bore A6 is located south east of the landfill.

Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
Temperature	⁰ C	11.5	N.D.	10.3 - 13.5
pH		6.8	6.8	5.8 - 7.6
Conductivity	μS/cm	2970	2901	158 - 5689
Alkalinity	g/m ³	550	575	280 - 943
Carbonaceous BOD5	g/m ³	1	1	1 - 6
Total Nitrogen	g/m ³	25	23	9.7 - 47.4
Total Ammoniacal Nitrogen	g/m ³	18	17	0.15 - 34.7
Fluoride	g/m ³	64	57	2 - 104
Sulphate	g/m ³	800	740	480 - 2050
Total Iron	g/m ³	24	23	4.2 - 40
Naphthalene	mg/m ³	0.27	0.50	<0.1 - 5
Anthracene	mg/m ³	0.100	0.10	0.0001 - 1.34
Phenanthrene	mg/m ³	0.20	0.20	<0.05 - 0.2
Fluoranthene	mg/m ³	0.10	0.10	<0.01 - 0.2
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 9.2
Total Kjeldahl Nitrogen	g/m ³	24	23	11.4 - 48
Nitrate Nitrogen	g/m ³	0.1	N.D.	0.001 - 14
Nitrite Nitrogen	g/m ³	0.2	N.D.	0.004 - 0.218
Weak Acid Dissociable Cyanide	g/m ³	0.0038	N.D.	0.0018 - 0.1
Boron	g/m ³	0.66	N.D.	0.64 - 2.54
Manganese	g/m ³	1.56	N.D.	0.22 - 1.85
Nickel	g/m ³	0.0026	N.D.	0.0041 - 0.022
Potassium	g/m ³	18	N.D.	11.1 - 37
Vanadium	g/m ³	0.08	N.D.	0.05 - 0.4

N.D: Not analysed – only required biennially.



Landfill Groundwater Monitoring, Continued

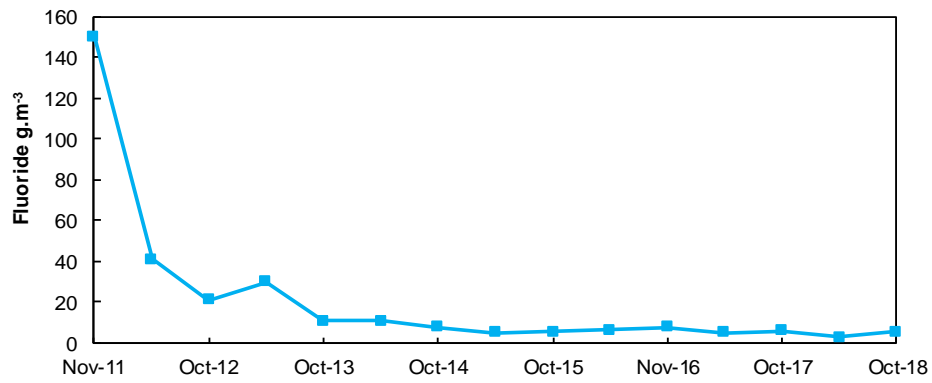
Bore T1A monitoring results

The table below shows a summary of results from samples collected from bore T1A during 2017 and 2018. Bore T1A is located east of the Haysoms DWP area.

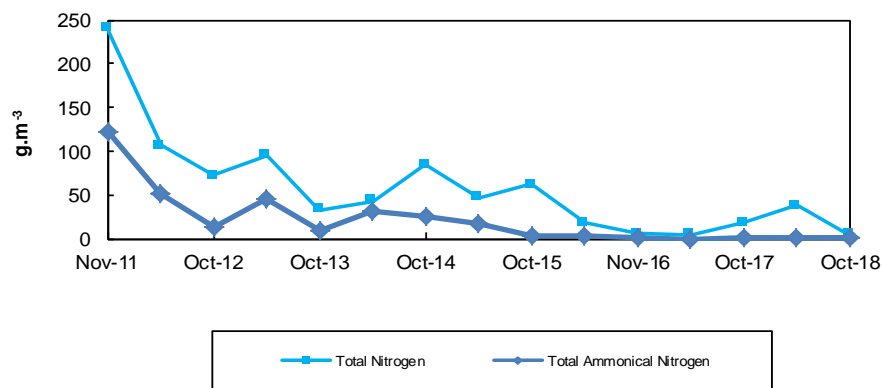
Analyte	Units	2017 Average	2018 Average	Range (since Commissioning)
pH	-	7.2	7.5	6.8 - 9.6
Alkalinity	g/m ³	152	240	74 - 2110
Temperature	°C	13.1	N.D.	10.6 - 13.7
Conductivity	µS/cm	652	896	461 - 8930
Carbonaceous BOD ₅	g/m ³	1	1	<1 - 10
Fluoride	g/m ³	6	4	<0.1 - 210
Sulphate	g/m ³	17	21	16 - 338
Total Iron	g/m ³	0.05	0.02	0.01 - 15.3
Boron	g/m ³	0.49	N.D.	0.05 - 12.6
Manganese	g/m ³	0.07	N.D.	0.0006 - 0.253
Potassium	g/m ³	11	N.D.	2.44 - 69.1
Vanadium	g/m ³	0.03	N.D.	<0.01 - 0.34
Nickel	g/m ³	<0.001	N.D.	<0.0005 - 0.044
Ammoniacal-Nitrogen	g/m ³	0	0.051	<0.01 - 580
Total Nitrogen	g/m ³	11	21	1.5 - 783
Total Kjeldahl Nitrogen	g/m ³	1	0	0.35 - 630
Nitrate Nitrogen	g/m ³	15.8	N.D.	1.25 - 229
Nitrite Nitrogen	g/m ³	<0.02	N.D.	0.003 - 20.8
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1
Weak Acid Dissociable Cyanide	g/m ³	<0.001	N.D.	<0.001 - 0.325

N.D: Not analysed – only required biennially.

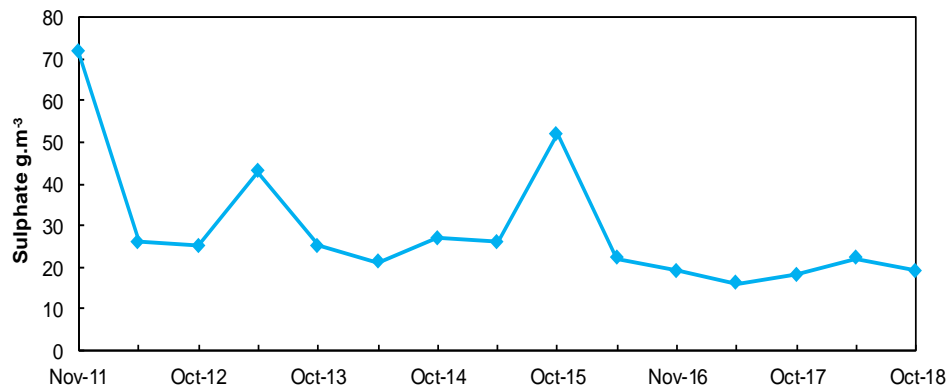
Bore T1A Fluoride



Bore T1A Nitrogen Species



Bore T1A Sulphate



Comments

The first monitoring survey for 2018 was carried out mid-May and the second at the end of October.

Two of the upstream bores (A20, A21) continue to show low levels of total nitrogen with typical levels of 1-6 gm^3 . Both bores show low levels of fluoride in the range of 1-10 gm^3 and were during 2018 on a decreasing trend. Sulphate levels in bore A20 spiked to 84 gm^3 in March 2018 but have returned to a usual level of 40-50 gm^3 in October 2018. Sulphate levels in bore A21 show an increasing trend.

The upstream bore, A41, has analytes remaining at steady low levels.

The bores to the west of the landfill (A22 and A23) continue to show a decreasing trend for total nitrogen. Bore A23 has fluoride and sulphate levels of below 0.5 gm^3 . Bore A22 had a sulphite spike in May 2018 but returned to normal levels for October 2018. Fluoride levels at Bore A22 are still at a low level but do show a spike during 2018 which may be due to the fire nearby in the landfill in September 2018.

A24, the bore to the east of the landfill, showed an increase in fluoride in October 2017 but has returned to normal levels during 2018. Total nitrogen levels continued to decrease during 2018. The level of sulphate is showing an increasing trend which may be due to a 38% increase in carbon to the landfill during 2018.

The bore to the south east of the landfill, A6, has shown a return to normal fluoride levels during 2018. Sulphate and nitrogen levels have plateaued over the last two years.

T1A, the bore located to the east of Haysom's DWP area shows all analytes remaining at very low levels. No material has been added or removed from the Haysoms Dross pile since it was buried in 2003.

Part L - Groundwater

Spent Cathode Pad Leachate

Monitoring of the groundwater during 2018 showed similar levels to 2017.

Spent Cell Lining Storage Shed

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2018. The concentration of fluoride and cyanide in the liquid between the membranes has not changed significantly.

Monitoring of the groundwater around the shed showed that the concentrations of cyanide and fluoride in the groundwater have not changed significantly.

Part M - Greenhouse Gas Discharges

Calculated Carbon Dioxide and Perfluorocarbon Discharges

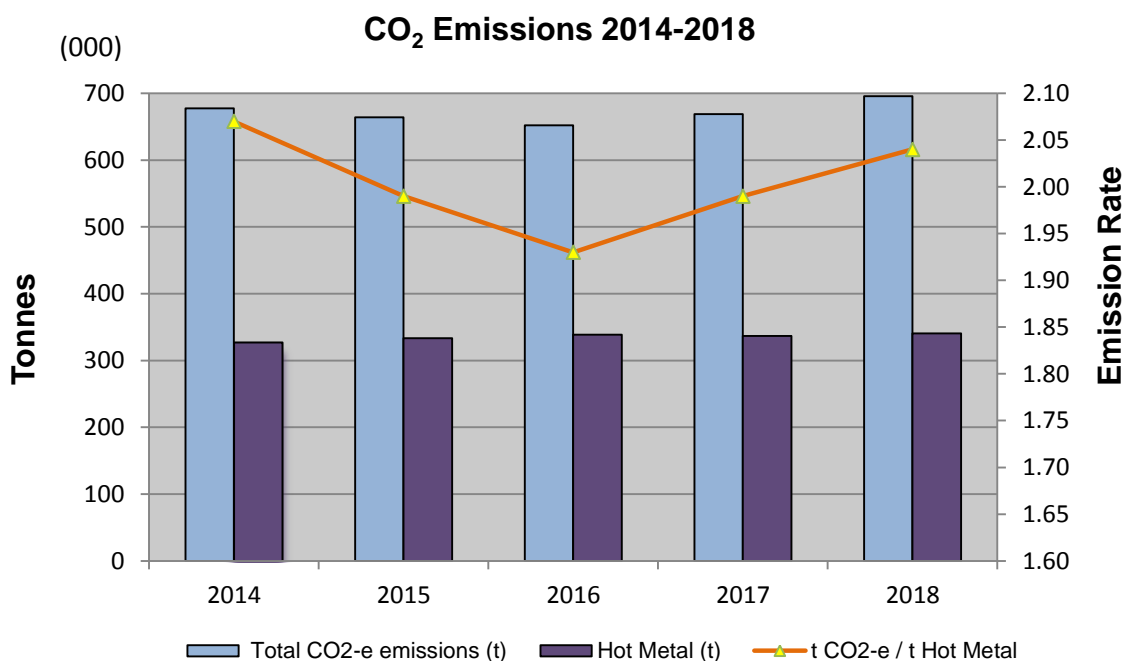
Introduction

Air Discharge Permit 203378 does not have a requirement to report calculated carbon dioxide and perfluorocarbon discharges from NZAS during each calendar year; however NZAS will continue to report this for general information purposes.

NZAS increased the metal production by 3,936 tonnes in 2018 compared to 2017 due to restarting 44 cells in Line 4 between October and December 2018.

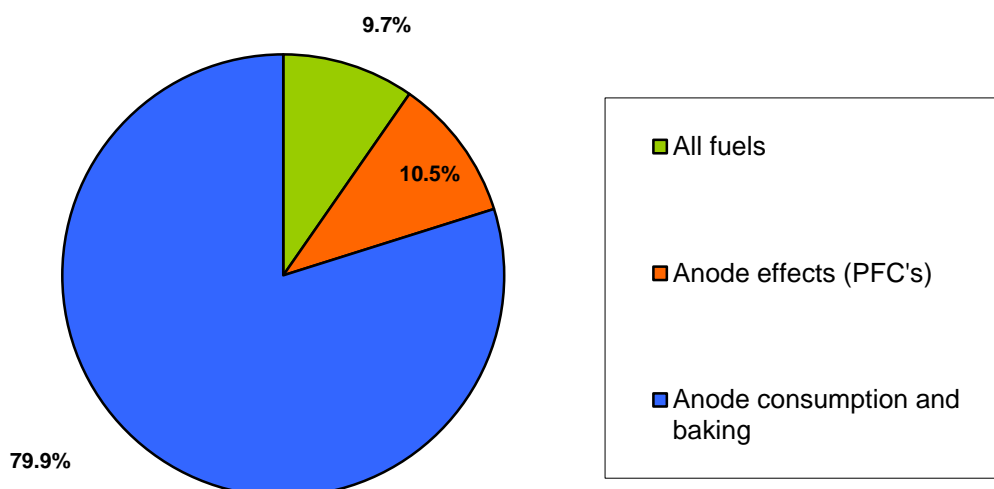
Carbon Dioxide - 2018

The total calculated carbon dioxide equivalent (CO₂-e) discharge from NZAS during the year ending 31 December 2018 was up 4% on last year. The average emission rate in 2018 was 2.04 t CO₂-e / per tonne of aluminium produced.



The total calculated CO₂ equivalents are emitted from carbon consumption (anodes), perfluorocarbons generation (PFCs) and fuel usage. The percentage distribution is displayed on the next page.

2018 NZAS Greenhouse Gas Profile



Anodes – 2018

A 2% total increase to the emissions contributed from anode baking and consumption was observed in 2018. The main reason was the start-up of 44 cells in Potline 4 which had been idle for several years. Emission of greenhouse gases during the production of aluminium is unavoidable as the consumption of carbon anode blocks form part of the chemical process to produce aluminium. However emissions can be minimised by manufacturing high quality anodes and ensure that they are not burning when in contact with air in the cells (airburn).

Perfluorocarbons – 2018

Perfluorocarbons (PFCs) contribute to climate change in the same way that CO₂ does. PFCs are gases emitted from the aluminium production process during instability of the cells. It is common to observe a high level of instability when starting up a new cell. The restart of Potline 4 cells during the last quarter of 2018 was the main contributor to an increase of 20% to the total quantity of PFCs discharged from the plant. The percentage of PFC's emitted as CO₂ equivalent out of the total greenhouse gas emission is slightly increased compared to 2017.

Fuel – 2018

Heavy fuel oil is the main fuel used on site and is used for baking the carbon anodes and heating of some casting furnaces. CO₂ equivalents from fuels were slightly increased compared to 2017 due to baking more anodes. The overall greenhouse gas contribution from fuels is just under 10% in line with the long term average of 10%.

Part N – Significant Spills

Reporting of significant spills at NZAS

Introduction

This chapter covers the impact assessment and remediation actions taken for significant spills impacting air, land or water due to the operations at NZAS.

Significant incidents in 2018

There were no significant environmental spills to report in 2018.

End of Report for 2018